FARR

TECHNICAL MANUAL

KT8625

8-5/8” (21.9cm) 25K

Hydraulic Power Tong

- *Specifications*
- *Operation*
- *Maintenance*
- *Assembly*

CE

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MOVING GLOBAL ENERGY FORWARD

This manual covers the following models:

TONG MODEL	REV	DESCRIPTION
80-0609-4	2	Tong with motor valve, rigid sling, and safety door.
80-0609-5	2	Tong with motor valve, rigid sling, safety door, and Wincatt dump valve.
80-0609-7	2	Tong with motor valve, lift valve, rigid sling, and safety door.
80-0609-8	0	Tong with motor valve, rigid sling, and safety door. Closed-centre system.

This technical manual applies to all CE-marked versions of the models listed in the table above.

PATENTED & PATENTS PENDING

NOTE: ***Some illustrations used in this manual may not exactly match your model of tong.***

ORIGINAL INSTRUCTIONS

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WARNINGS

A "LOAD-BEARING DEVICE" IS A CHAIN SLING, RIGID SLING, SPREADER BAR ASSEMBLY, FRAME, OR ANY OTHER DEVICE THAT BEARS THE PARTIAL OR TOTAL WEIGHT OF THE EQUIPMENT FOR WHICH THIS MANUAL HAS BEEN PRODUCED

THE LOAD-BEARING DEVICE SUPPLIED BY MCCOY DRILLING & COMPLETIONS IS DESIGNED TO SUPPORT THE EQUIPMENT DESCRIBED IN THIS MANUAL. MCCOY DRILLING & COMPLETIONS WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO SUPPORT ANY OTHER PART, ASSEMBLY OR COMBINATION OF PARTS AND ASSEMBLIES. MCCOY DRILLING & COMPLETIONS WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO LIFT OR SUPPORT THE EQUIPMENT DESCRIBED IN THIS MANUAL IF THERE ARE ANY MODIFICATIONS TO THE LOAD-BEARING DEVICE, OR ANY ADDITIONS TO THE EQUIPMENT DESCRIBED IN THIS MANUAL THAT ADD WEIGHT TO THE EQUIPMENT, UNLESS SUPPLIED BY MCCOY DRILLING & COMPLETIONS.

WHEN RE-ASSEMBLING LOAD-BEARING DEVICES (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS, ETC.) NOTE THAT THE ASSOCIATED FASTENERS MUST BE TIGHTENED TO THE CORRECT TORQUE SPECIFIED FOR THAT SIZE OF FASTENER (SEE SECTION 3 - OVERHAUL). ANY THREADED FASTENER IN A LOAD-BEARING DEVICE MUST BE SECURED WITH RED OR BLUE LOCTITE™.

ANY REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.

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McCoy has made every effort to ensure the information contained in this document is accurate and current. This manual is intended to provide equipment operation and safety instructions for your equipment. However, McCoy does not warrant or guarantee that the information is either complete or accurate in every respect and the user of the manual should consult with its McCoy sales representative for any clarifications and updates.

The user of the manual shall protect, indemnify, and hold harmless McCoy and its directors, officers, employees, and agents from and against all liability for personal injury, death, or property damage resulting directly or indirectly from the use of the information contained in this manual.

Observance of all descriptions, information and instructions set out in this manual is the full responsibility of the user. This manual is intended for guidance and informational purposes and must be used in association with adequate training and on-the-job supervision to provide safe and effective equipment use.

It is the responsibility of the user to conform to all regulations and requirements issued by an authority or agency which may affect the operation, safety or equipment integrity, that may overrule the content of this documentation.

The user will acknowledge and obey any general legal or other mandatory regulation in force relating to accident prevention, safety, and equipment integrity.

Summary Of Revisions				
Date	**Section**	**Page**	**Description Of Revision**	**Approved**
Sep 2007	N/A	N/A	Initial Release	KI
JUNE 2009	Intro	iii	Added closed-centre model to table.	DB
		v	Inserted load-bearing and assembly warnings.	
	3	3.1	Added load bearing device / sling safety section	
		3.7	Added closed-centre outlet to parts list	
		3.9	Added closed-centre hydraulic schematic	
	6	6.31	Added closed-centre outlet to parts list	
	Appendices	Appendix 1	Added power tong daily maintenance checklist	
		Appendix 2	Added power tong monthly maintenance checklist	
		Appendix 3	Added backup daily maintenance checklist	
		Appendix 4	Added power unit daily maintenance checklist	
		Appendix 5	Added power tong decommissioning checklist	
		Appendix 6	Added power tong recommissioning checklist	
DEC 2009	6	6.30, 6.31	Added additional working section to hydraulic valve assembly illustration to cover model 80-0609CM	KD
	3	3.10, 3.20	Added optional schematic to show **CHROMEMASTER™** valve section, updated operation illustration	
NOV 2010	N/A	N/A	Revised manual to reflect support roller and cage plate design changes	DB
MAY 2012	All	All	Updated manual to current branding standards	SH
	Intro	iii	Removed unsupported & "backup ready" tong models from list	
		x	Inserted list of illustrations	
	1	1.3	Inserted illustration of additional hazard areas	
		1.4	Inserted illustration & identification of FARR CE Nameplate	
		1.5	Corrected specifications page	
	2	All	Moved "Tong Assembly" to "Maintenance" section. "Setup & Operation" re-numbered as Section 2.	
		2.1	Inserted new section "Initial Receipt & Inspection of Equipment"	
		2.1	Renumbered section 2.B, "Major Component Identification"	
		2.4	Renumbered section 2.C, "Sling & Load-Bearing Device Safety"	
		2.7	Inserted new section 2.D, "Lift Cylinder Installation"	

Continued on next page

Summary Of Revisions (Continued):				
Date	**Section**	**Page**	**Description Of Revision**	**Approved**
MAY 2012	2	2.8	Removed obsolete hydraulic schematics from section 2.E, "Hydraulic Schematics and Component Identification	SH
		2.12	Inserted CE-applicable hydraulic schematic (Open Centre)	
		2.13	Inserted CE-applicable hydraulic schematic (Closed Centre)	
		2.17	Revised section 2.G, "Tong Jaw Availability & Installation"	
		2.19	Inserted new section 2.H, "Tong Rig-up & Leveling"	
		2.22	Inserted new subsection 2.I.1, "Operator Training"	
		2.22	Inserted new subsection 2.I.2, "Operator Safety"	
		2.23	Revised subsection 2.I.3, "Valve Operation"	
		2.24	Inserted new subsection 2.I.4, "Shifting Gears"	
		2.25	Inserted new subsection 2.I.5, "Pre-operational Checks"	
		2.27	Inserted new section 2.J, "Making & Breaking Connections"	
	3	3.1	Inserted new section 3.A, "General Maintenance Safety Practices"	
		3.1	Inserted new section 3.C, "Preventive Maintenance Practices"	
		3.2	Inserted new section 3.D, "Hydraulic System De-Pressurizing"	
		3.2	Renumbered section 3.E, "Lubrication Instructions"	
		3.2-3.7	Replaced illustrations Section 3.E, "Lubrication Instructions"	
		3.7	Inserted lubrication instruction 3.E.10, "Door Stop Cylinder"	
		3.6	Renumbered section 3.F, "Adjustments"	
		3.8	Revised subsection 3.F.1, "Brake Band Adjustment"	
		3.9	Replaced illustration, subsection 3.F.2, "Door Latch Cam Adjustment"	
		3.10	Inserted new subsection 3.F.3, "Shifter Detent Force Adjustment"	
		3.10	Inserted new subsection 3.F.4, "Safety Door Adjustment"	
		3.11	Renumbered section 3.G, "Recommended Periodic Checks"	
		3.12-3.13	Renumbered & revised section 3.H, Overhaul Procedures - Disassembly. Corrected disassembly procedures and added CE-specific information and warnings.	
		3.14-3.25	Inserted new section 3.I, "Assembly Procedures" including CE-specific information and warnings.	
		3.26	Inserted new section 3.J, "Power Tong Daily Inspection & Maintenance", removed from appendices. Added CE-Specific information.	
		3.28	Inserted new section 3.K, "Power Tong Monthly Inspection & Maintenance", removed from appendices	
		3.31	Inserted new section 3.L, "Tubular Connection Equipment De-Commissioning", removed from appendices. Revised section to add packaging and shipping instructions and retitled "Tubular Connection Equipment De-Commissioning & Shipping".	
		3.35	Inserted new section 3.M, "Tubular Connection Equipment Re-Commissioning", removed from appendices	
	4	4.1	Revised section 4.A, Troubleshooting - Tong Will Not Develop Sufficient Torque	
		4.2	Inserted new section 4.B, Troubleshooting - Relief Valve	
		4.4	Inserted new section 4.C, Troubleshooting - Safety Door	
		4.5	Renumbered section 4.D, Troubleshooting - Tong Running Too Slowly	
		4.6	Renumbered section 4.E, Troubleshooting - Failure of Jaws to Grip Pipe	
		4.7	Renumbered section 4.F, Troubleshooting - Shifting	

Continued on next page

Summary Of Revisions (Continued):				
Date	**Section**	**Page**	**Description Of Revision**	**Approved**
MAY 2012	5	5.2	Inserted list of critical spare parts	SH
		5.3	Inserted list of recommended spare parts	
		5.4	Inserted list of parts needed for complete overhaul	
		5.10-5.11	Replaced illustrations & corrected B.O.M., Support Roller - Door Pivot	
		5.12-5.13	Replaced illustrations, Rotary Idler	
		5.14-5.15	Replaced illustrations & revised B.O.M., Pinion Idler	
		5.16-5.17	Replaced illustrations, Pinion	
		5.18-5.19	Replaced illustrations & revised B.O.M., Clutch	
		5.20-5.21	Replaced illustrations & revised B.O.M., Shifter	
		5.22-5.23	Replaced illustrations & revised B.O.M. to reflect changes to backing pin, Rotary Assembly	
			Removed illustration & B.O.M., Hydraulic Assembly	
		5.24-5.25	Replaced illustrations, Tong Leg Assemblies	
		5.26-5.27	Inserted new illustration & B.O.M., "Hydraulic Supports"	
		5.28-5.29	Replaced illustrations & revised B.O.M., Motor & Motor Mount Assembly	
		5.30-5.31	Replaced illustrations & revised B.O.M., Brake Bands	
			Removed illustration & B.O.M., Hydraulic Assembly	
		5.32-5.33	Revised illustrations & B.O.M., "Tong Door Assembly"	
		5.34-5.35	Replaced illustrations & revised B.O.M., Safety Door Components. Added addition B.O.M. for CE-specific components.	
		5.36-5.37	Replaced illustrations & revised B.O.M., Rigid Sling. Added addition illustration and B.O.M. for CE-specific components.	
	6	All	Complete revision of Torque Measurement section	

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The information presented in this document will provide setup, operating, and maintenance instructions for your KT8625 tong. Due to the wide variety of operating conditions, these instructions must be considered guidelines rather than absolute operating procedures. It is the responsibility of the user to use these guidelines together with an experienced manager to develop operating procedures that conform to all policies set forth by the operating authority (ies).

IDENTIFICATION OF OF WARNINGS AND OTHER NOMENCLATURE OF IMPORTANCE USED IN THIS INSTALLATION GUIDE

McCoy Drilling & Completions | FARR. uses these indicators to describe items of three degrees of importance.

*A **HAZARD** to operators or equipment is represented by an exclamation point within a red triangle and identifies items of the highest importance. Failure to heed information identified by a **HAZARD** symbol may result in bodily injury, death, catastrophic equipment damage, or any combination of these. A **HAZARD** may also indicate the potential for dangerous environmental contamination.*

This identifies a HAZARD to operators or equipment

*A **WARNING** is represented by an exclamation point within an orange triangle, and contains information that will alert personnel to a potential safety hazard that is not life-threatening. A **WARNING** may also serve to alert the user to information critical to the correct assembly or operation of the equipment in use.*

This identifies a WARNING to users

*A **CAUTION** is represented by an exclamation point within a yellow triangle and highlights information that may aid the user during assembly or operation of your equipment. CAUTIONs are also used to ensure common errors are not made during assembly or operation of your equipment.*

This identifies a CAUTION to users

*Some sections of this technical manual apply only to "**CE Marked**" equipment. These sections will be clearly identified by the use of the phrase "applies to CE-marked tongs only", or by use of the CE logo within an enclosed border.*

This identifies a section that only applies to CE-Marked equipment

Observance of the following is the full responsibility of the user:

- ***all descriptions, information and instructions set out in this manual***
- ***any regulation or requirement issued by an authority or agency which may influence operation, safety or integrity of the equipment that overrules the content of this document.***
- ***any legal or other mandatory regulation in force governing accident prevention or environmental protection.***

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Congratulations on the purchase of your FARR® KT8625 8-5/8" tong. This unit will provide you with years of outstanding performance. Simple maintenance and care will extend its life and ensure years of excellent performance and reliability. The setup, operating, and maintenance instructions in this manual will assist you in giving your equipment the care it requires. Please carefully read the manual before installing and using your equipment. Replacement parts are readily available from McCoy Drilling & Completions | FARR in Edmonton Alberta. Note that many parts are transferable between FARR® tongs and backups. Should you need replacement parts, or should you experience any difficulty not covered in this manual, please contact:

McCoy Drilling & Completions | FARR

14755 121A Avenue
Edmonton, Alberta
Canada T5L 2T2
Phone: 780.453.3277
Fax: 780.455.2432

Sales Fax: 780.481.9246

Email Engineering: engFarr@mccoyglobal.com

Email Sales: salesFarr@mccoyglobal.com

Website: http://www.mccoyglobal.com/drilling-completions

MODEL 80-0609-7 SHOWN

ILLUSTRATION 1.A.1: KT8625 TONG

Color Coding:

Green *= Handle or control, safe to grasp or manipulate*

Yellow *= Active or potential hazard. Use caution not to contact area especially when tong is rotating.*

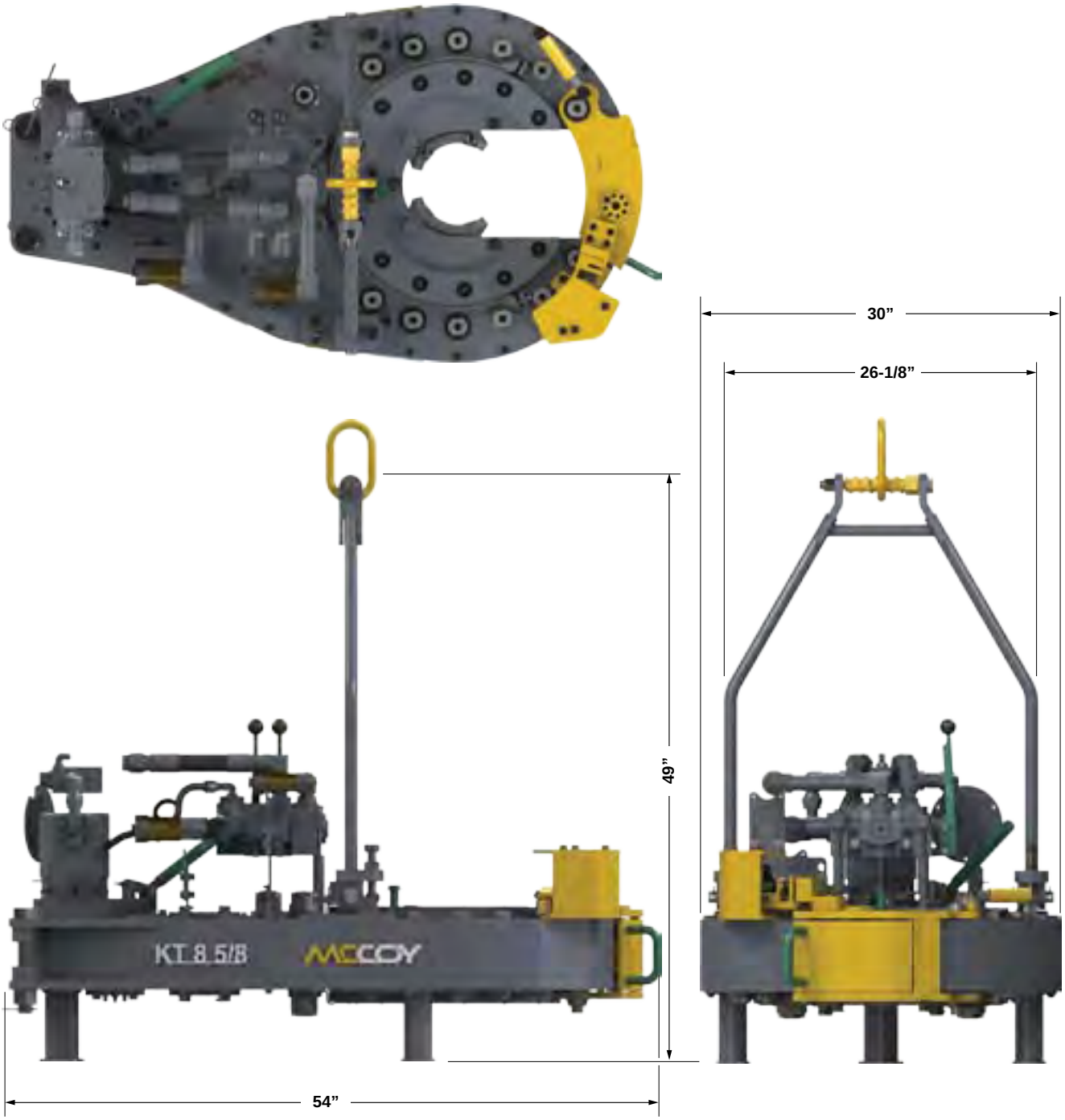
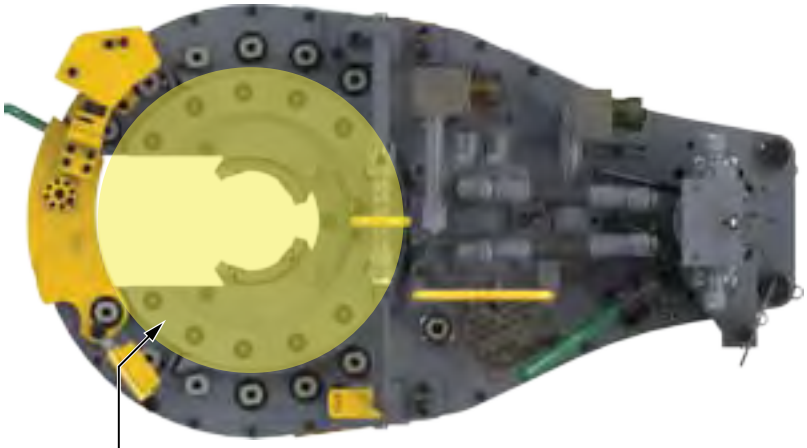


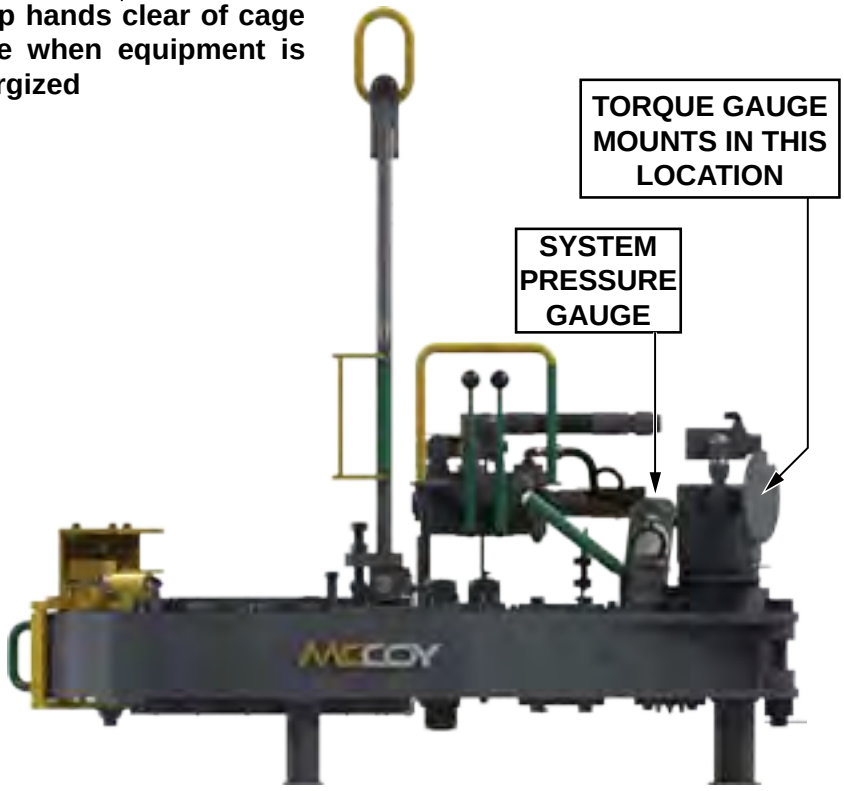
ILLUSTRATION 1.A.2: KT8625 TONG DIMENSIONS

In addition to the **HAZARD** areas of this equipment that are coated **YELLOW**, the rotating cage plate assembly poses a significant hazard when the equipment is active. Keep hands clear of the cage plate when equipment is energized. **SAFE** areas to handle while the equipment is energized are indicated by **GREEN** coating

CE



Keep hands clear of cage plate when equipment is energized



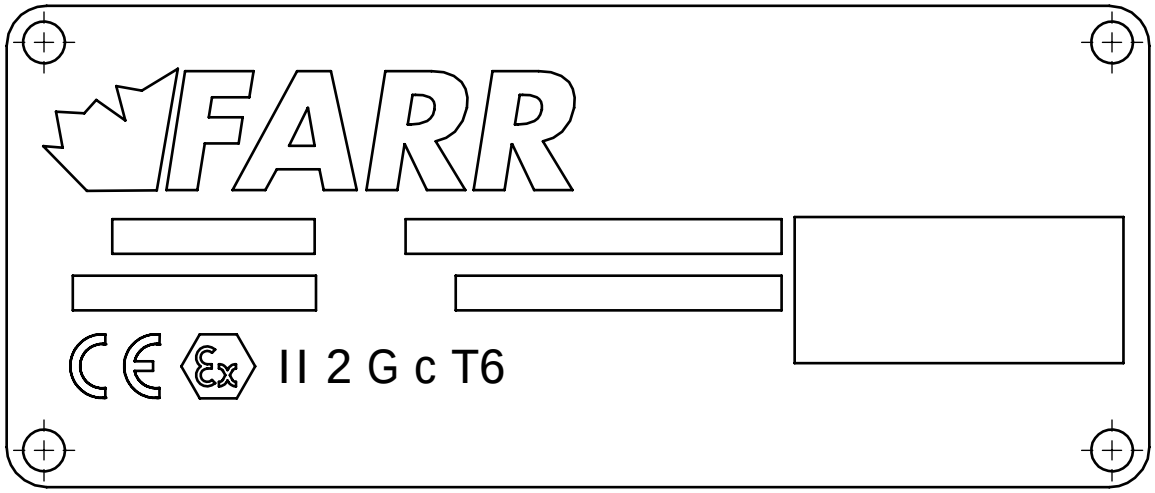


ILLUSTRATION 1.A.5: FARR® CE NAMEPLATE

CE compliant. Conforms with the essential requirements of the applicable Conformité Européenne directives.

EU Explosive Atmosphere certified

II *Equipment Group (surface, non-mining)*

2 *Equipment Category - high level of protection*

Gc *Gas Group (Acetylene & Hydrogen) - Certified for use in an acetylene / hydrogen environment*

T6 *Maximum surface temperature of 85 °C.*

Torque Table **				
Pressure	**High Gear**		**Low Gear**	
PSI / MPa	**Lbs.-ft.**	**Nm**	**Lbs.-ft.**	**Nm**
1000 / 6.89	1800	2440	8900	12067
1500 / 10.34	3100	4203	15300	20744
2000 / 13.79	4400	5966	21600	29286
2300 / 15.17	5100	6915	25400	34438
MAXIMUM RATED TORQUE: 25000 LBS.-FT. (25354 Nm)				
MAXIMUM SYSTEM PRESSURE: 2285 PSI (15.7545 MPa)				

Speed Table		
Flow (US GPM / LPM)	**Low Gear (RPM)**	**High Gear (RPM)**
10 / 37.9	2.0	10.0
20 / 75.71	4.0	19.0
40 / 151.4	8.0	39.0
60 / 227.1	12.0	58.0

** ***These are ideal values. Actual achieved torque is highly dependant upon tong efficiency, final position of rotary gear when full torque load is reached, and the motor with which the tong is equipped.***

Maximum Hydraulic Requirements	60 GPM (227.1 LPM)
	2500 PSI (17.237 MPa)
Maximum Dimensions	
Length (Doors Closed)	54" / 137.2 cm
Height	49" / 124.5 cm
Width	30" / 76.2 cm
Maximum Elevator Diameter	Unlimited (tong comes off pipe)
Torque Arm Length (Pipe center to anchor center)	36" / 91.4 cm
Dead Weight (Approximate)	1550 lbs / 705 kg
Max. Working Weight (inc. Spring Hanger)	2300 lbs / 1045 kg
Sound Level (dBa)	97 dB A @ 1m / 96 dB C @ 1m
Jaws available (inches)	All standard sizes from 2.062" to 8-5/8" (See Pg. 2.14)
Recommended Spring Hanger	85-0106X (Capacity = 1800 lbs / 818 kg)

ONLY USE SPRING HANGER SUPPLIED BY MCCOY. IF USING SPRING HANGER REFER TO SECTION 2.H FOR PROPER RIGGING INSTRUCTIONS.

ALL REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.

Use an EP synthetic grease that meets or exceeds the following specifications:

Thickener	*Lithium Complex*
NLGI consistency grade	*2*
NLGI performance grade	*GC-LB*
Penetration - ASTM D 217 (25°C [77°F]	*265-295 minimum*
0.1 mm) worked 60 strokes	
Dropping point, °F[°C] - ASTM D2265	*550 [288] minimum*
High temperature life, hours - ASTM D 3527	*160 minimum*
Oxidation stability, psi - ASTM D 942	*(100 hr/300 hr) 0/3*
Water washout, percent - ASTM D 1264	*1.8 max*
Rust and corrosion - ASTM D 1743	*pass*
Oil separation, percent loss - ASTM D 1742	*1.1 max*
(24 hours, 25°C [77°F]	
Leakage, g lost - ASTM D 4290	*1.0 max*
Four ball wear test, mm scar - ASTM D 2266	*0.40 max*
Fretting wear, mg - ASTM D 4170	*3.4 max*
Four ball EP, kgf - ASTM D 2596	
Weld point	*400 minimum*
Load wear index	*50 minimum*
Timken OK load test, lbs - ASTM D 2509	*50*
*Low temperature torque, N*m - ASTM D 4693*	*1.3 max*
(-40°C [-40°F])	
LT-37 pumpability, g/min	*360/7*
(60°F/0°F [16°C/-18°C])	
Copper corrosion - ASTM D 4048	*1B*
Disc brake wheel bearing specifications	
Ford ESA-M1C 198A	*Yes*
Chrysler MS-3701	*Yes*
Oil viscosity: 40°C [104°F], cSt	*151*
100°C [212°F], cSt	*19.2*
Flash point, °F[°C] - ASTM 92	*450[232]*

Use a premium quality hydraulic fluid that meets or exceeds the following specifications:

Typical Density (kg/m3)	*878*
Viscosity - cSt @ 40 °C	*68.8*
- cSt @ 100 °C	*8.7*
Viscosity Index	*97*
Pour Point °F [°C]	*-22 [-30]*
Flash Point °F [°C]	*432 [222]*
Colour, ASTM	*1.5*
Neutralization Number	*0.40*
Rust Protection - Distilled Water	*No Rust*
- Sea Water	*No Rust*
Hydrolytic Stability - Cu Mass Loss, mg/cm2	*0.04*
Copper Corrosion Test	*1A*
Filterability: Denison - Wet & Dry	*Pass*
Afnor - Wet & Dry	*Pass*
Cincinatti Milacron Spec Approved	*P69*
Denison HF-0:	*Approved*
Denison P-46 Piston Pump:	*Pass*
Denison T6C Vane Pump:	*Pass*
Vickers 35VQ25 Vane Pump Test:	*Pass*
104/105C Vane Pump Test:	*No Data Available*
Vane pump test total ring and vane wear, mg.	*<10*
Oxidation Stability	
Turbine Oil Stability Test Life, hours	*2500+*
Rotary Bomb Oxidation Test, minutes	*325*
FZG Spur Gear Test, Failure Load Stage (FLS)	*12*

Adequate setup and proper hydraulic connections are essential in ensuring reliable operation of your tong. For best results and long term reliability, read and obey the start-up instructions in this section.

A. INITIAL RECEIPT AND INSPECTION OF EQUIPMENT

YOUR EQUIPMENT HAS BEEN THOROUGHLY TESTED AND INSPECTED AT THE FACTORY. HOWEVER, MCCOY ADVISES INSPECTING YOUR EQUIPMENT FOR SHIPPING DAMAGE UPON RECEIPT AND TESTING YOUR TONG BEFORE RELEASING TO AN OPERATIONAL ENVIRONMENT.

Perform a visual inspection following removal of all packaging material. Immediately identify any shipping damage to the shipping company, and correct all damage before connecting equipment to a hydraulic power source.

B. MAJOR COMPONENT IDENTIFICATION

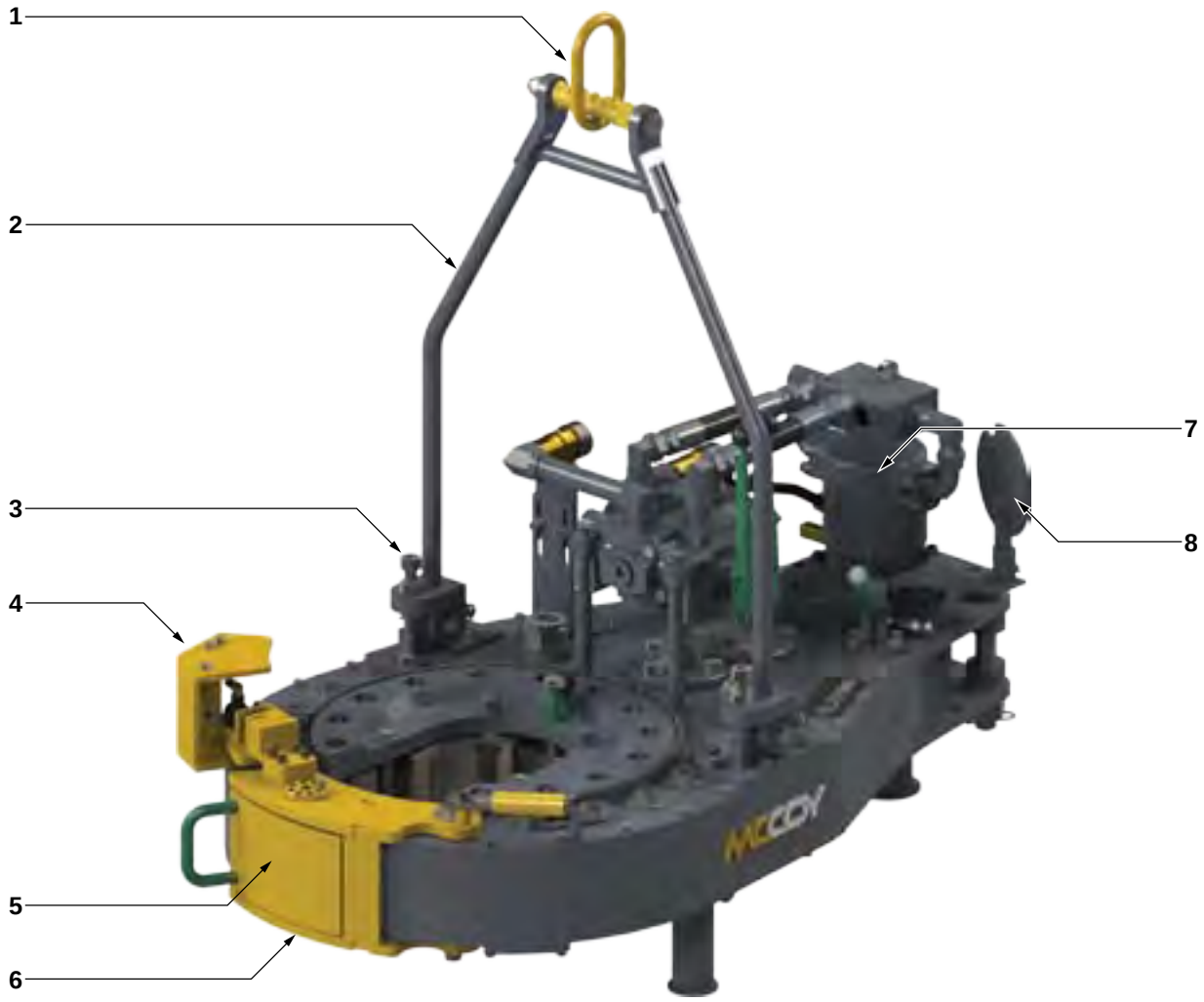


ILLUSTRATION 2.B.1: COMPONENT ID 01

Item	Description
1	Master Lifting Link
2	Rigid Sling
3	Rigid Sling Leveling Device
4	Safety Door Switch Assembly
5	Tong Door Latch
6	Tong Door
7	Hydraulic Motor
8	Torque Gauge Mounting Plate

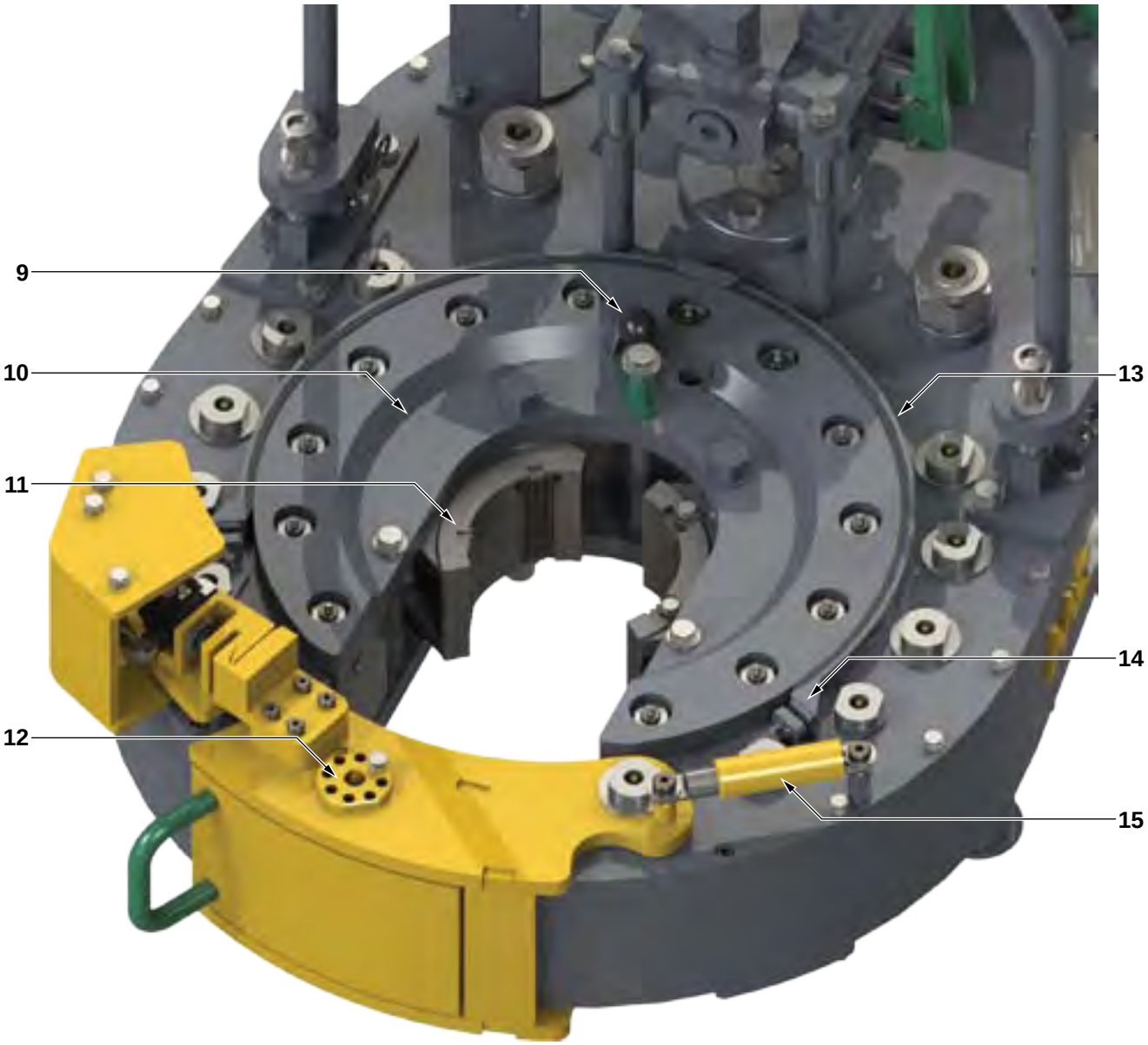


ILLUSTRATION 2.B.2: COMPONENT ID 02

Item	Description
9	Backing Pin Assembly
10	Cage Plate Assembly
11	Tong Jaws with Die Inserts
12	Door Latch Adjustment Cam
13	Brake Band
14	Brake Band Adjustment
15	Tong Door Spring Cylinder

ILLUSTRATION 2.B.3: COMPONENT ID 03

Item	Description
16	Manual Shift Assembly
17	Valve Bank Assembly
18	Motor Mount
19	Access Panel

C. SLING / LOAD BEARING DEVICE SAFETY

THE SUPPLIED LOAD-BEARING DEVICE (CHAIN SLING, RIGID SLING, SPREADER BAR ASSEMBLY, FRAME, OR ANY OTHER DEVICE THAT BEARS THE PARTIAL OR TOTAL WEIGHT OF THE EQUIPMENT DESCRIBED IN THIS MANUAL) HAS BEEN SPECIFIED OR DESIGNED TO SUPPORT THE EQUIPMENT DESCRIBED IN THIS DOCUMENT. FARR WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO SUPPORT ANY OTHER PART, ASSEMBLY OR COMBINATION OF PARTS AND ASSEMBLIES, OR ANY ADDITIONS TO THE EQUIPMENT DESCRIBED IN THIS MANUAL THAT ADD WEIGHT TO THE EQUIPMENT, UNLESS SUPPLIED BY MCCOY DRILLING & COMPLETIONS.

MCCOY DRILLING & COMPLETIONS DOES NOT GUARANTEE THE INTEGRITY OF MODIFIED OR DAMAGED LOAD-BEARING DEVICES, UNLESS THOSE MODIFICATIONS ARE PERFORMED BY MCCOY DRILLING & COMPLETIONS.

McCoy Drilling & Completions recommends following an industry-accepted standard such as OSHA, ASME B30.9-2006, or manufacturer's guidelines when performing any rigging and overhead lifting. Use by untrained persons is hazardous. Improper use will result in serious injury or death. Do not exceed rated capacity. Slings will fail if damaged, abused, misused, overused, or improperly maintained.

- *Only grade 80 or grade 100 alloy chain should be used for overhead lifting applications.*
- *Working Load Limit (WLL) is the maximum allowable load in pounds which may be applied to the load-bearing device, when the device is new or in "as new" condition, and when the load is uniformly and directly applied. The WLL must never be exceeded.*
- *Working Load Limit (WLL) is the maximum working load for a specific minimum sling angle, measured from the horizontal plane. The Working Load Limit is identified on the sling.*
- *The Working Load Limit or Design factor may be affected by wear, misuse, overloading, corrosion, deformation, intentional alterations, sharp corner cutting action and other use conditions.*
- *Shock loading and extraordinary conditions must be taken into account when selecting alloy chain slings.*
- *See OSHA Regulation for Slings 1910.184, ANSI/ASME B30.9-"SLINGS", ANSI/ASME B30.10-"HOOKS" and ANSI/AMSE B30.26 "RIGGING HARDWARE" for additional information.*

THE MINIMUM SLING ANGLE (THE ANGLE OF THE LEG OF THE SLING MEASURED FROM THE HORIZONTAL) MUST NEVER FALL LOWER THAN THE ANGLE SPECIFIED FOR THE SLING IN USE

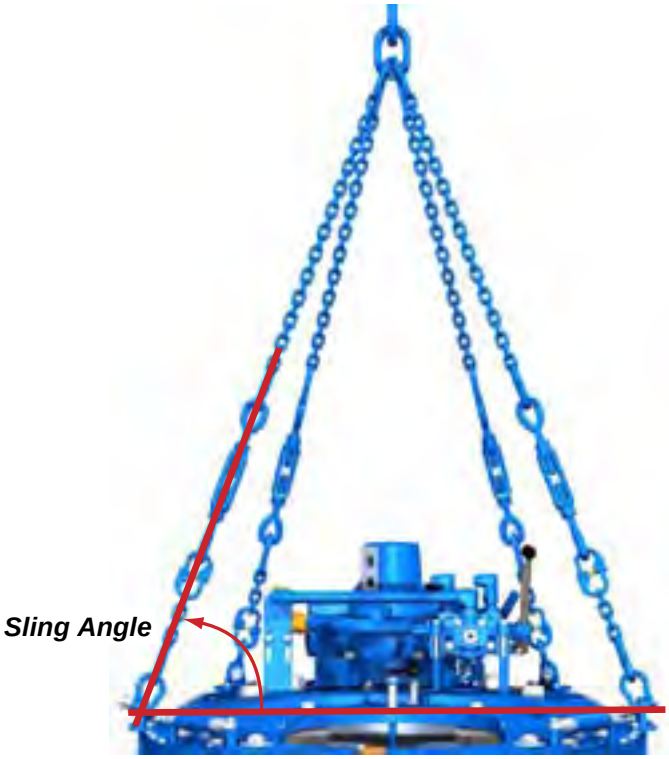


ILLUSTRATION 2.C.1: SLING ANGLE

1. Inspection Of Slings

Farr strongly recommends the following practices:

A complete inspection of new load-bearing devices and attachments shall be performed by a qualified, designated person prior to initial use. Each link and component shall be examined individually, taking care to expose and examine all surfaces including the inner link surface. The sling shall be examined for conditions such as those listed in the removal criteria below. In addition, daily inspection of slings, fastenings and attachments shall be performed by a designated person. If damage or defects are found at either inspection, the damaged or defective component shall be quarantined from service until it can be properly repaired or replaced.

Removal Criteria:

A load-bearing device shall be removed from service if conditions such as the following are present:

- *Missing or illegible sling identification.*
- *Cracks or breaks*
- *Evidence of tampering is seen - sling tag has been modified or obscured, or tamper-proof nuts are missing.*
- *Signs of impact on load-bearing components, including spreader bars, lifting lugs, rigid slings & rigid sling weldments, and legs & leg mounts.*
- *Broken or damaged welds.*
- *Excessive wear, nicks, or gouges. Refer to the chart below to ensure minimum thickness on chain links supplied is not be below the values listed:*

Minimum Allowable Chain Link Thickness at Any Point			
Nominal Chain Size		Minimum Thickness	
Inches	MM	Inches	MM
7/32	5.5	0.189	4.80
9/32	7	0.239	6.07
5/16	8	0.273	6.93
3/8	10	0.342	8.69
1/2	13	0.443	11.26
5/8	16	0.546	13.87
3/4	20	0.687	17.45
7/8	22	0.750	19.05
1	26	0.887	22.53
1-1/4	32	1.091	27.71
Refer To ASME B30.9			

- *Stretched, bent, twisted, or deformed chain links or components.*
- *Evidence of heat damage.*
- *Excessive pitting or corrosion.*
- *Lack of ability of chain or components to hinge (articulate) freely.*
- *Weld splatter.*
- *For hooks, removal criteria as stated in ASME B30.10*
- *Other conditions, including visible damage, that cause doubt as to the continued use of the sling.*

Inspect all lugs and fixing points for signs of elongation and/or bending, or for material build-up around the hole. Repair or replace components that appear distorted. Ensure all hardware is tight and in good condition. Replace missing hardware if necessary. All hardware must be free of rust and corrosion.

Additional inspections shall be performed during sling use where service conditions warrant. Periodic inspection intervals shall not exceed one year. The frequency of periodic inspections should be based on:

- *Frequency of use of the load-bearing device.*
- *Severity of service conditions*
- *Nature of lifts being made*
- *Experience gained on the service life of load-bearing devices used in similar circumstances.*

Guidelines for the interval are:

- *Normal Service - yearly*
- *Severe Service - monthly to quarterly*
- *Special Service - as recommended by a qualified person*

Units designed and manufactured in accordance with EN 12079 and DNV 2.7-1 should be tested and examined in accordance with the following schedule of examination and test. The user of the load-bearing device shall place a permanent placard or plate upon which the type and date of the last test shall be recorded. To avoid confusion, the plate shall not carry the date of the next test or examination, only the most recent.

Test / Examination				
Time / Interval	Lifting Tests[1]	Non-Destructive Examination (NDE) of Lifting Points	Thorough Visual Examination	Suffix To Be Marked On Plate Attached To Unit
Initial Certification By Farr / Superior	YES	YES	YES	T
Interval Not Exceeding 12 Months	At the discretion of inspection body	At the discretion of inspection body	YES	T or VN[3]
Interval Not Exceeding 60 Months	At the discretion of inspection body	YES	YES	T or VN
Following Substantial Repair or Alteration[4]	YES	YES	YES	T

1. Lifting test as per S 7.3 BS EN 12079 or DNV 2.7-1 May 1995
2. T = Proof Test, non-destructive examination; VN = non destructive examination and visual examination; V = visual examination.
3. Dependant upon whether non-destructive examination has been carried out.
4. For the purposes of this standard, a substantial repair or modification is defined as any repair and/or modification that has been carried out which may, in the opinion of the inspection body, affect the load-bearing elements of the container or lifting device, or elements that contribute directly to its structural integrity.

IF MECHANICAL DAMAGE IS SEEN OR SUSPECTED ON A LOAD-BEARING DEVICE, OR IF THE LOAD-BEARING DEVICE HAS BEEN OVERLOADED, IT MUST BE REMOVED FROM SERVICE AND QUARANTINED UNTIL RECERTIFIED

Written records of the most recent periodic inspection shall be maintained, and shall include the condition of the sling.

2. Proper Use Of Load-Bearing Devices

Whenever any load-bearing device is used, the following practices shall be observed.

- *Load-bearing devices that are damaged or defective shall not be used.*
- *Slings shall not be shortened with knots or bolts or other makeshift devices.*
- *Sling legs shall not be kinked.*
- *Load-bearing devices shall not be loaded in excess of their rated capacities.*
- *Slings shall be securely attached to their load.*
- *Load-bearing devices shall be protected from snagging, and shall not be further obstructed by any object.*
- *Suspended loads shall be kept clear of all obstruction.*
- *All employees shall be kept clear of loads about to be lifted and of suspended loads.*
- *Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load.*
- *Shock loading is prohibited.*
- *Do not stand directly under a load during lifting.*

3. Storage Of Load-Bearing Devices

Proper storage of out-of-service load bearing devices is important to ensure full integrity of the device once it is returned to service. Farr recommends observing the following practices.

- *Wipe off all excess grease. Use a solvent-based cleaner on rags to wipe all external surfaces to remove residual grease or hydraulic fluid. Once the outside surfaces have been de-greased, wipe all external surfaces with clean water to remove residual solvent.*
- *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external surfaces. Refer to manufacturer data sheets for proper application and safety information. Allow the anti-corrosive coating ample time to dry - refer to manufacturer data sheets for drying times at room temperature.*
- *Store in a clean, dry location. When returning to service, note that a full inspection of the device must be performed.*

D. LIFT CYLINDER INSTALLATION

The lift cylinder is not orientation-specific; that is, the lift cylinder will function the same way independent of which end is connected to the crane and which end is connected to the main lifting lug of the tong (or the spring hanger, if used). However, McCoy recommends orienting the lift cylinder with the hydraulic hose connection at the bottom of the cylinder to ensure the hose is not stressed when cylinder is at full extension.

TEST LIFT CYLINDER BEFORE INSTALLATION. REFER TO THE LIFT CYLINDER TECHNICAL MANUAL FOR DETAILED TESTING AND OPERATING PROCEDURES, AND DETAILED SAFETY GUIDELINES.

IF USING A SPRING HANGER ITS WEIGHT MUST BE ACCOUNTED FOR WHEN CALCULATING TOTAL SUSPENDED WEIGHT.

1. Installation Procedure

i. *Use a crane to hoist the lift cylinder by the shackle, ensuring the hydraulic hose connection is at the bottom of the cylinder when it is hoisted.*

ii. *Remove the two R-clips securing the clevis pin, and remove the clevis pin.*

iii. *Orient the spring hanger so the piston will extend down during thread make-up, preventing water and debris from gathering around the seal.*

iv. *Place the welded U-connection inside the clevis. Replace the clevis pin, and secure the clevis pin with the two R-clips.*

v. *Hoist the lift cylinder and spring hanger.*

vi. *Place a 1" shackle around the master lifting link on the tong sling. Secure the shackle to the extending end of the spring hanger using the 1-1/8" UNC x 4-3/4" modified hex bolt and 1-1/8" UNC hex jam nut. Secure the jam nut to the bolt using a 3/16" x 1-1/4" cotter pin.*

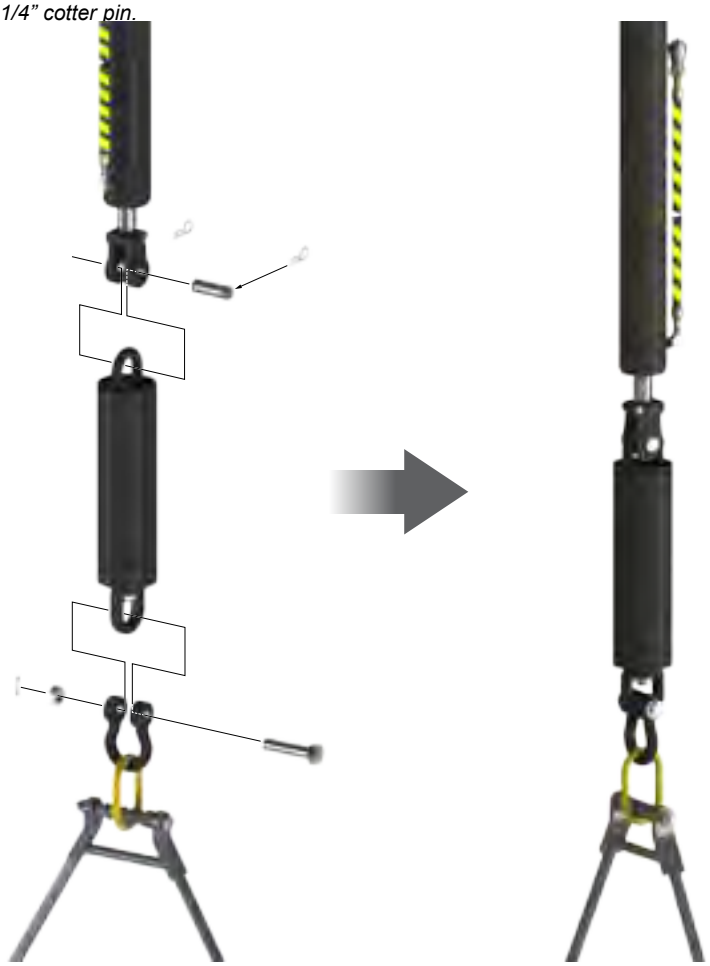


ILLUSTRATION 2.D.1: LIFT CYLINDER & SPRING HANGER INSTALLATION

2. Lift Cylinder Connection

Inspect the hydraulic hose before connection, ensuring the line is free of ruptures, cracks, cuts, or other damage. Inspect the female quick-connect fitting to ensure it is free from damage. Connect the female quick-connect on the lift cylinder hydraulic hose to the male quick-connect fitting attached to the needle valve on the tong valve bank. Once the fitting has snapped into place give the hydraulic line a light tug upwards to ensure the fitting is securely seated.

If not already done, connect the main hydraulic supply to the power tong (see section 2.F for proper hydraulic connection procedure). Energize the hydraulic supply to the power tong.

Lift the power tong approximately three inches off the work surface, and suspend the tong for approximately thirty seconds. Following the suspension alternately lift and lower the tong slightly to confirm that lift and lower functions each operate correctly.

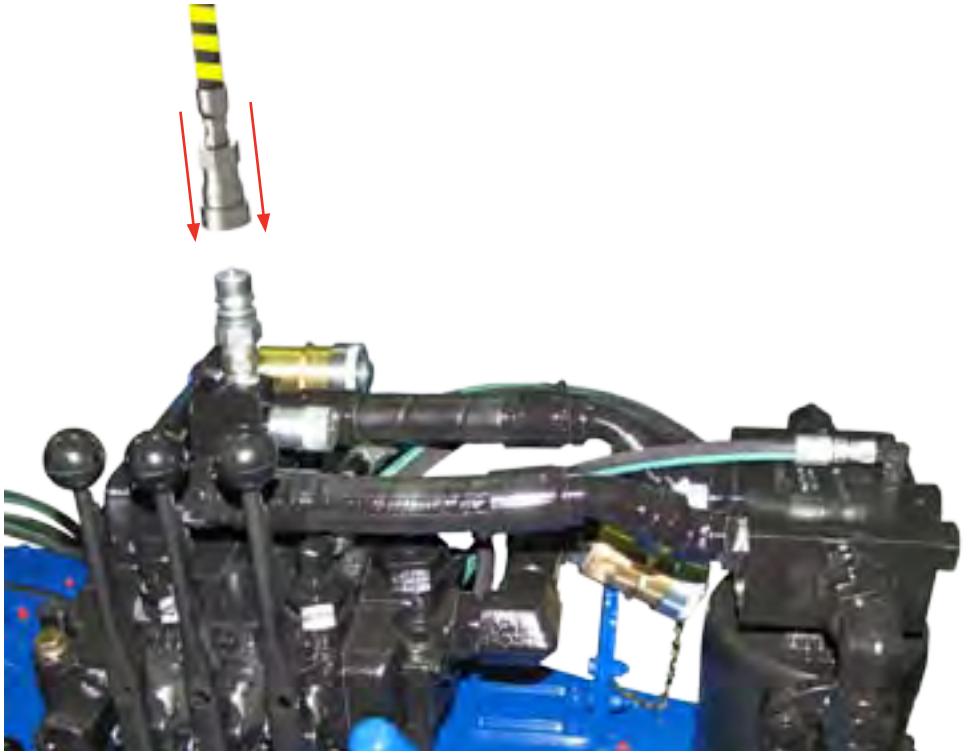


ILLUSTRATION 2.D.2: LIFT CYLINDER HYDRAULIC CONNECTION

3. Lift Cylinder Safety

A CLEARLY IDENTIFIED REMOTE POWER PACK EMERGENCY STOP MUST BE INSTALLED IN THE IMMEDIATE VICINITY OF THE TONG OPERATOR.

McCoy Drilling & Completions recommends following an industry-accepted standard such as OSHA, ASME B30.9-2006, or manufacturer's guidelines when performing any rigging and overhead lifting. Use by untrained persons is hazardous. Improper use will result in serious injury or death. Do not exceed rated capacity.

Working Load Limit (WLL) is the maximum allowable load in pounds which may be applied to the load-bearing device, when the device is new or in "as new" condition, and when the load is uniformly and directly applied. The WLL must never be exceeded.

The Working Load Limit or Design factor may be affected by wear, misuse, overloading, corrosion, deformation, intentional alterations, sharp corner cutting action and other use conditions.

See OSHA Regulation for Slings 1910.184, ANSI/ASME B30.9-"SLINGS", ANSI/ASME B30.10-"HOOKS" and ANSI/AMSE B30.26 "RIGGING HARDWARE" for additional information.

Lift Cylinder Safety (continued):

The flexible line providing hydraulic power to the lift cylinder has been equipped with abrasion-resistant, high visibility protective wrap. The high visibility wrap allows operators to easily see monitor the position of the hydraulic line at all times, and can easily see if the line appears to become entangled or snagged.

IMMEDIATELY CEASE LIFT CYLINDER OPERATION IN THE EVENT OF ENTANGLEMENT OF THE HYDRAULIC LINE WITH FIXED RIG COMPONENTS OR TONG SUPERSTRUCTURE.

The protective wrap also prevents wear of the hydraulic line though abrasion. Do not remove the protective wrap from the lift cylinder line, and replace protective wrap if it is missing, torn, or split. Regardless of use or condition, the hydraulic line supplying the lift cylinder must be replaced every two years.

REPLACE LIFT CYLINDER HYDRAULIC LINE EVERY TWO YEARS

The control valve section on the power tong is equipped with an internal check valve, preventing sudden drop of the tong in the event of hydraulic power failure. A speed-limiting orifice is installed in the breather port of the lift cylinder. The orifice prevents sudden drop of the lift cylinder in the event of a ruptured hydraulic line, limiting the speed at which the cylinder extends and the tong drops to a safe rate. Do not remove the speed-limiting orifice, and only replace with an identical orifice supplied by McCoy.

DO NOT REMOVE THE SPEED-LIMITING ORIFICE FROM THE LIFT CYLINDER BREATHER PORT

The working load limit (WLL) is clearly stenciled on to the side of the lift cylinder. Do not use lift cylinder if the WLL stencil has been rubbed off or intentionally removed. Locate the test certificate that accompanied the cylinder to the job site or, if necessary, obtain a copy of the test certificate from the location at which the original certificate has been stored. The lift cylinder must be clearly re-marked with the WLL before it is released to an operating environment.

DO NOT USE A LIFT CYLINDER WITH A MISSING OR DEFACED WLL STENCIL.

E. HYDRAULIC SCHEMATIC / COMPONENT IDENTIFICATION

Your tong may not be equipped with a lift valve, and may be configured to be open-centre or closed centre, depending upon the specific model.

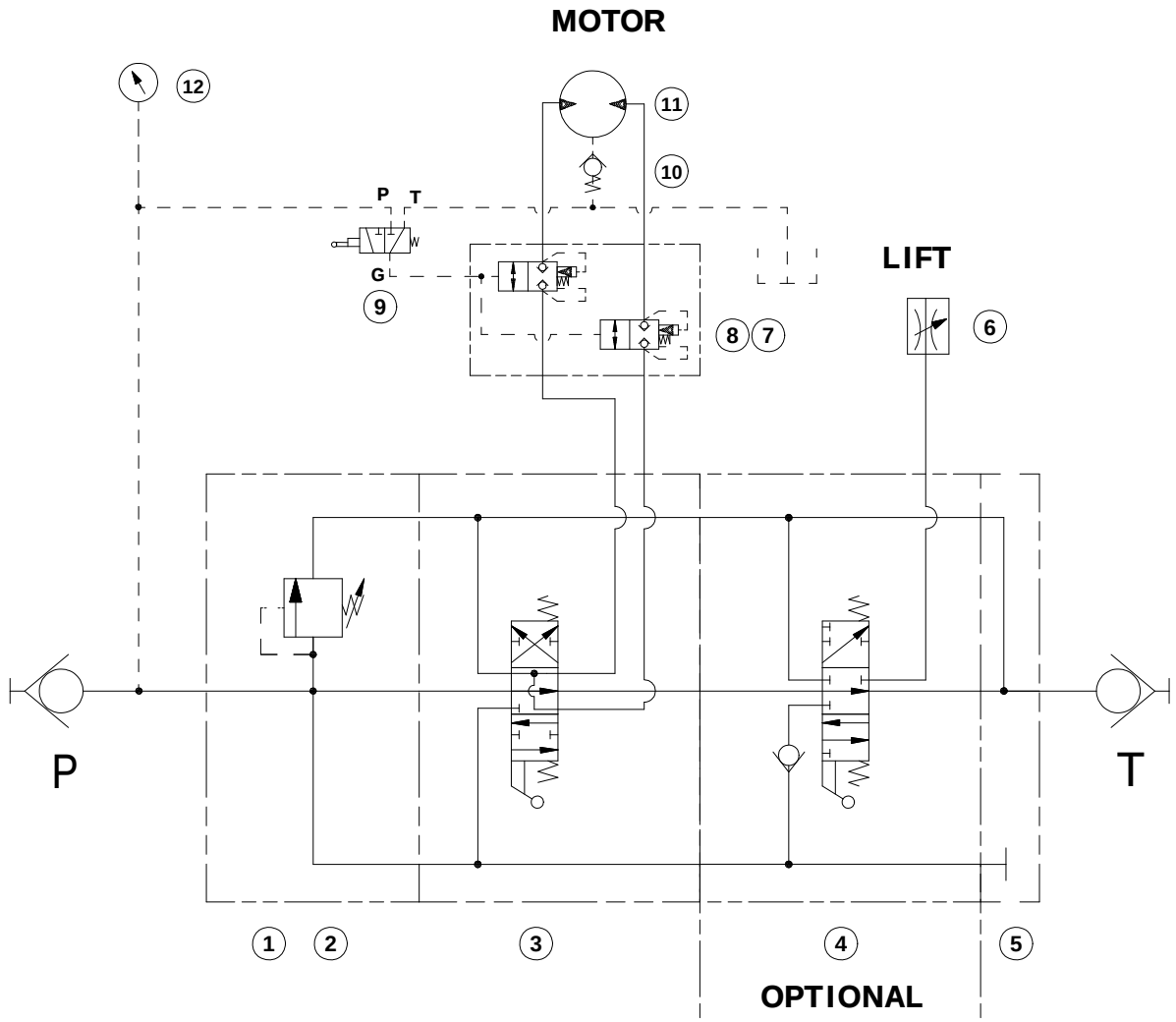


ILLUSTRATION 2.E.1: HYDRAULIC SCHEMATIC (OPEN CENTRE)

Item	Description	Part Number
1	Inlet Valve DVA35	10-9016
2	Relief Valve, DVA35	10-0010R
3	Motor Section	10-9014
4	Lift Section (Optional)	10-9015
5	Outlet Section	10-0086
5A	Outlet Section - Closed Centre (Optional)	08-1825
6	Lift Cylinder Flow Control Valve	08-9062
7	Safety Door Valve Block	101-0727
8	Pilot-To-Operate Cartridge Valve (For safety door system)	08-1625
9	Safety Door Switch	08-0337
10	Hydraulic Motor	87-0112
11	Check Valve	02-9022
12	Pressure Gauge, 0 - 3000 PSI	02-0245
13	Lift Cylinder Orifice	

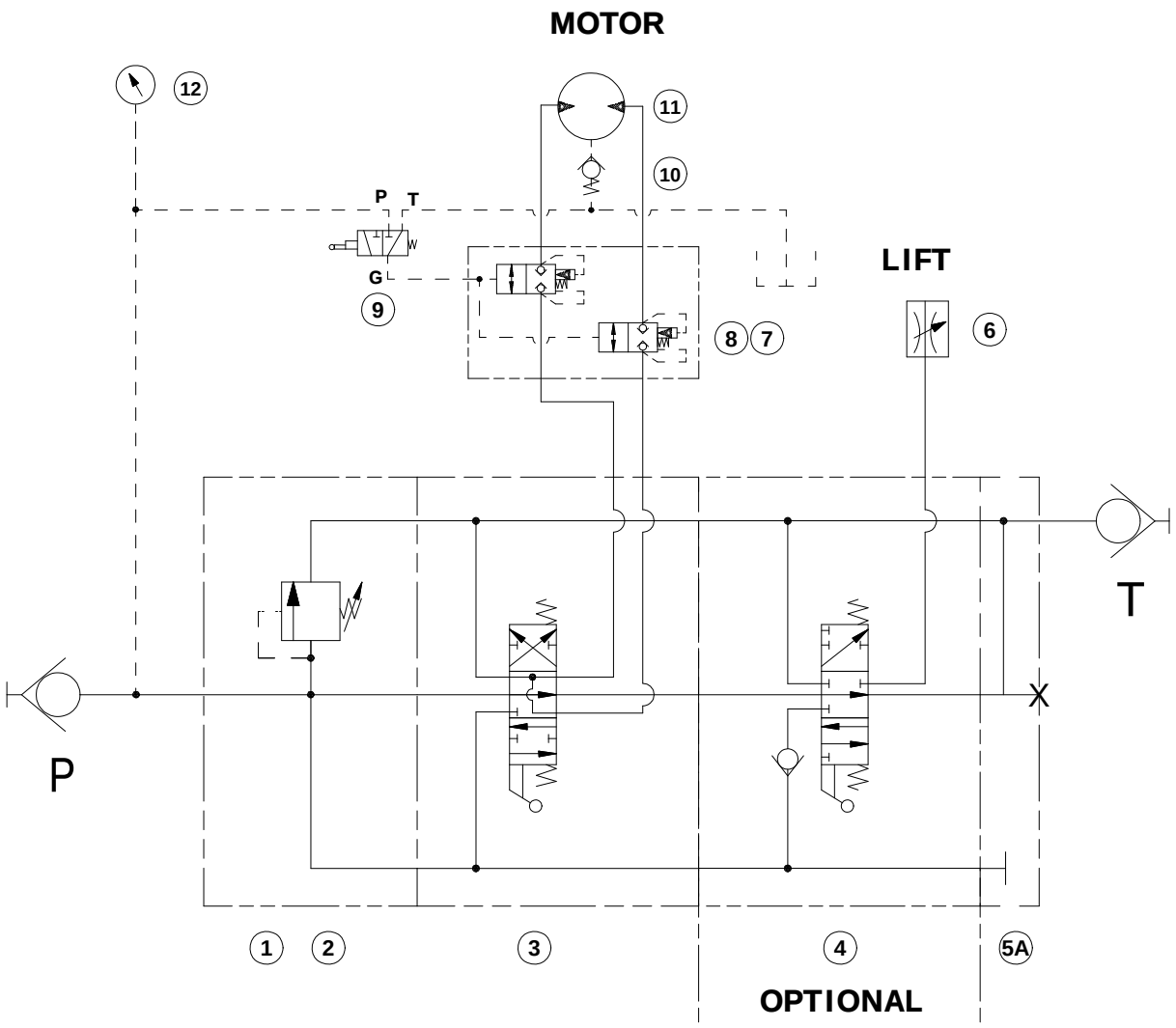


ILLUSTRATION 2.E.2: HYDRAULIC SCHEMATIC (CLOSED CENTRE)

THE RELIEF PRESSURE VALVE IS FACTORY-SET TO OPTIMIZE THE PERFORMANCE OF YOUR EQUIPMENT. DO NOT ADJUST THE RELIEF VALVE WITHOUT FIRST CONSULTING MCCOY DRILLING & COMPLETIONS | FARR.

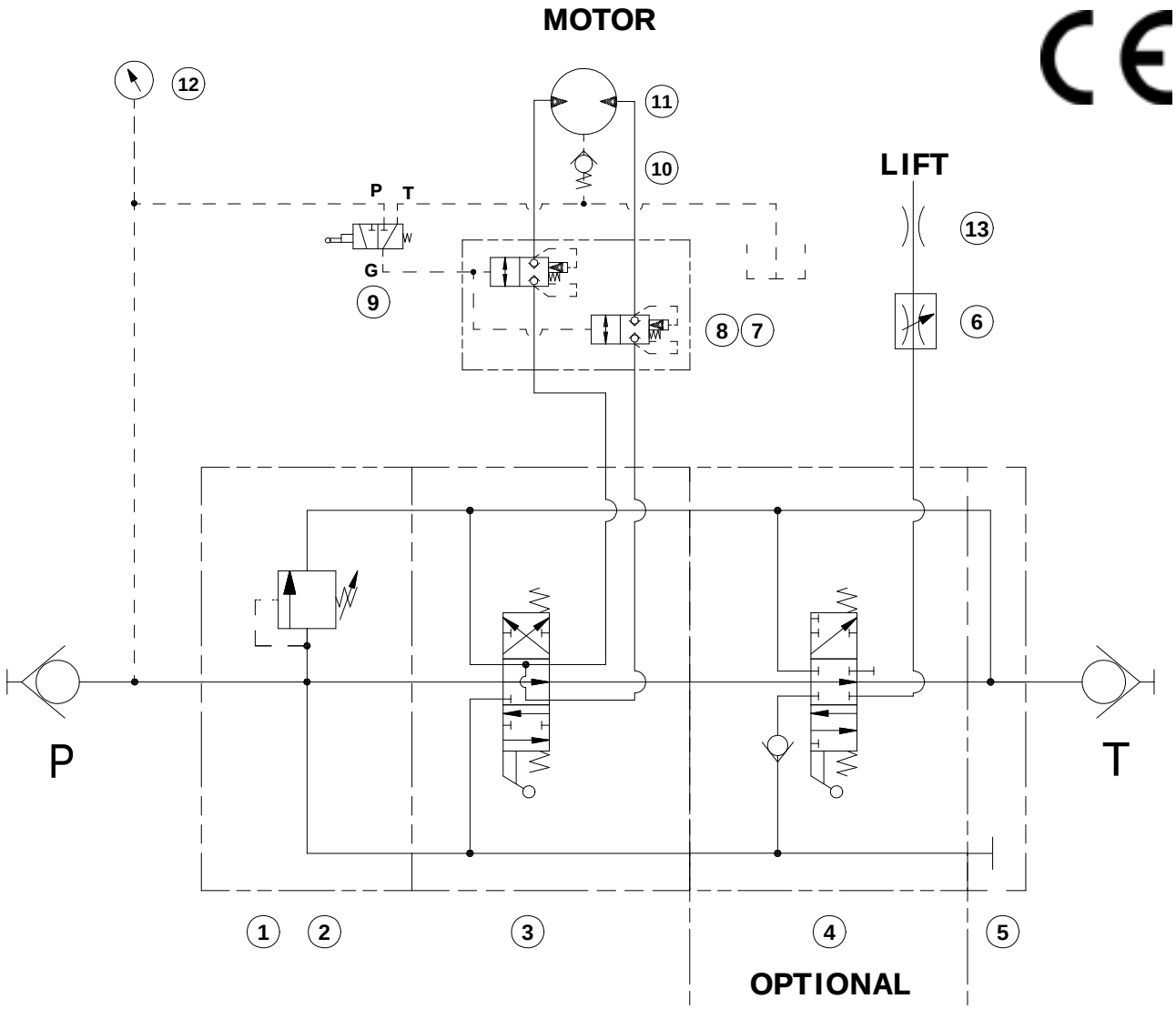


ILLUSTRATION 2.E.3: HYDRAULIC SCHEMATIC (OPEN CENTRE) CE MARKED

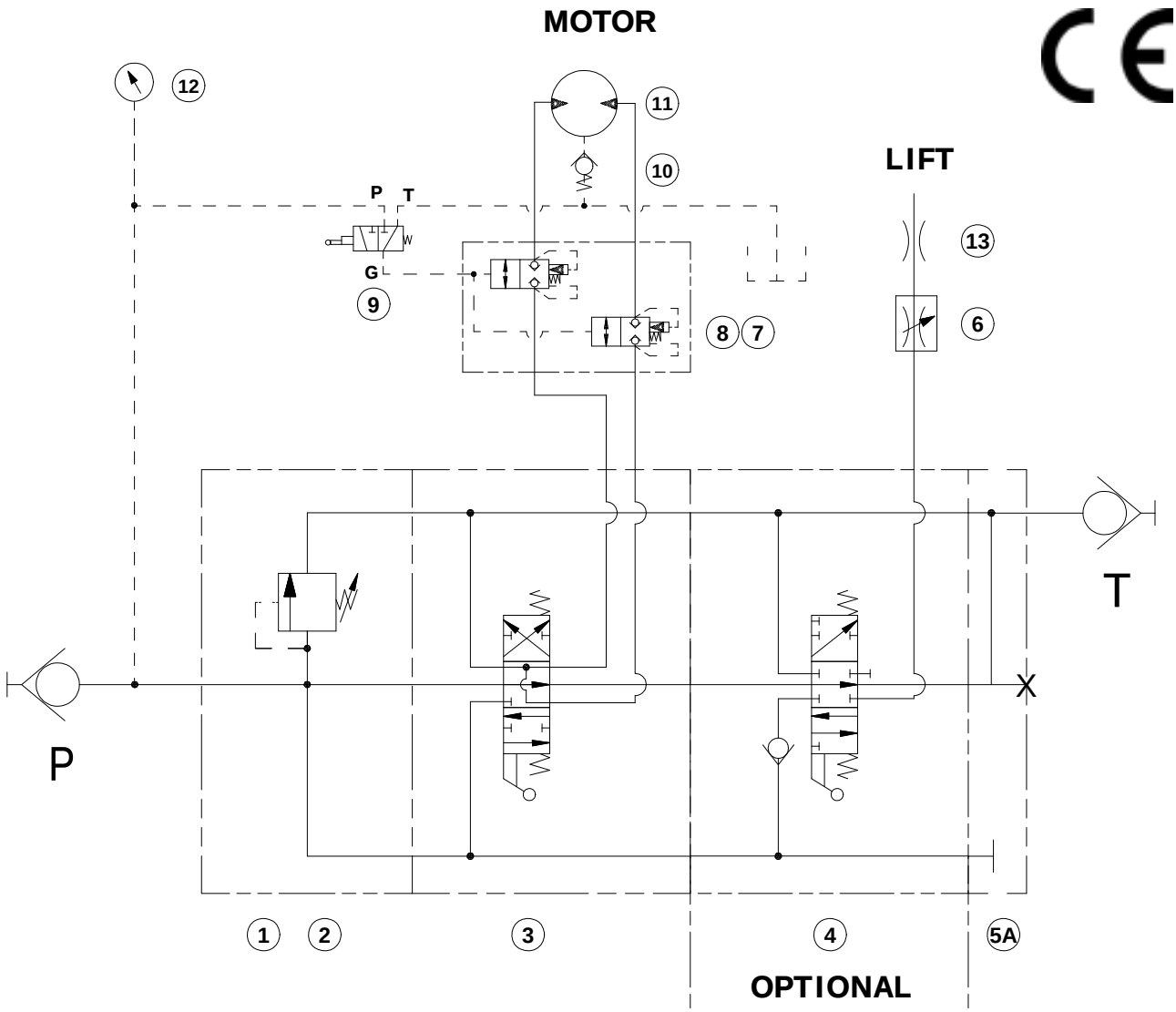


ILLUSTRATION 2.E.4: HYDRAULIC SCHEMATIC (CLOSED CENTRE) CE MARKED

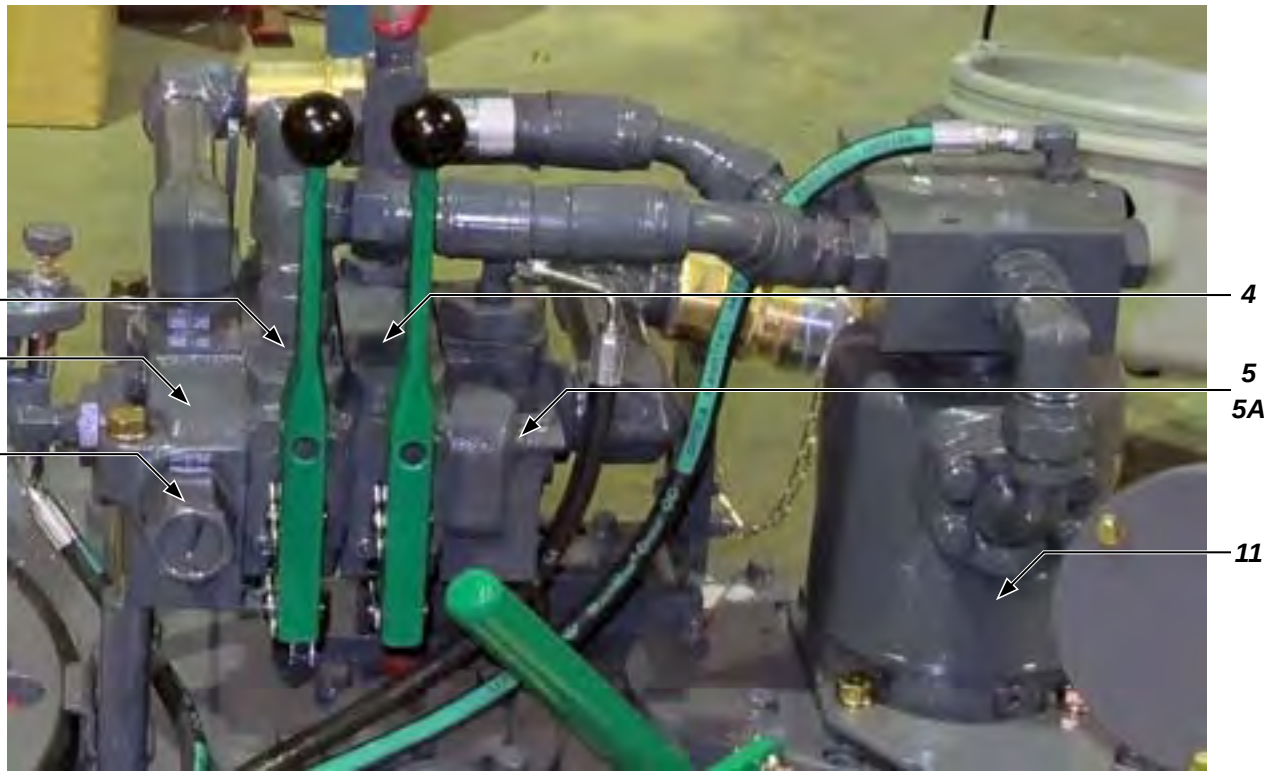


ILLUSTRATION 2.E.5: HYDRAULIC COMPONENT ID 01

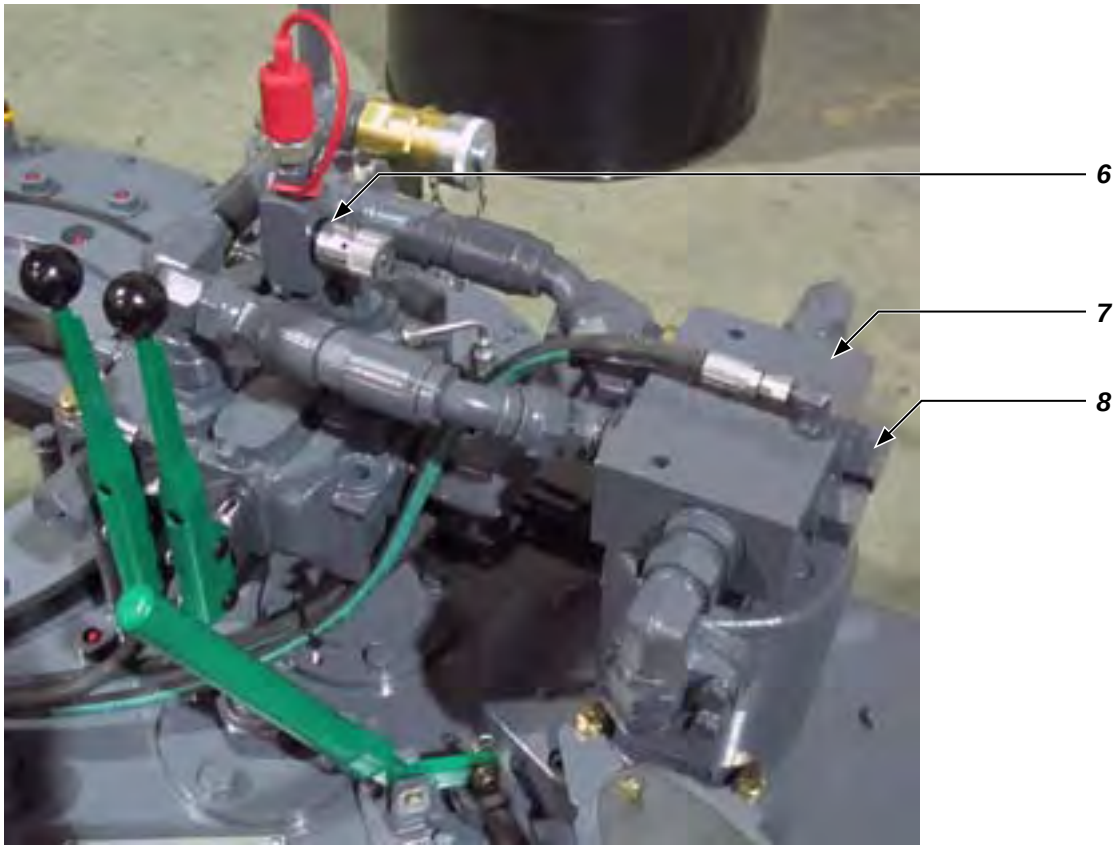


ILLUSTRATION 2.E.6: HYDRAULIC COMPONENT ID 02

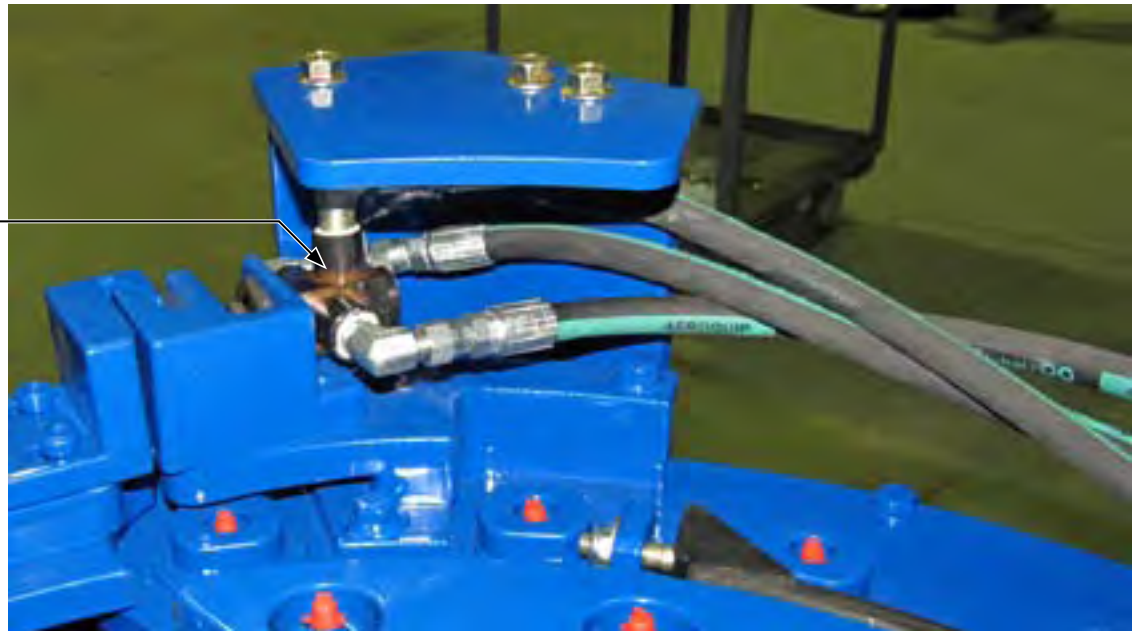


ILLUSTRATION 2.E.7: HYDRAULIC COMPONENT ID 03

F. HYDRAULIC CONNECTIONS

1. Main Hydraulic Connections

A pair of hydraulic lines - a 1" supply line and a 1-1/4" return line - connect the tong to the power unit (see illustration below). Ancillary devices (hydraulic motors, hydraulic cylinders, etc.) are connected through the valve block.

Perform any hydraulic connection when the power unit is not running, or when the hydraulic pump is disengaged. The possibility of error in inter-changing the high pressure supply hose and the low pressure return hose has been eliminated, because the supply side coupling is smaller than the return side.

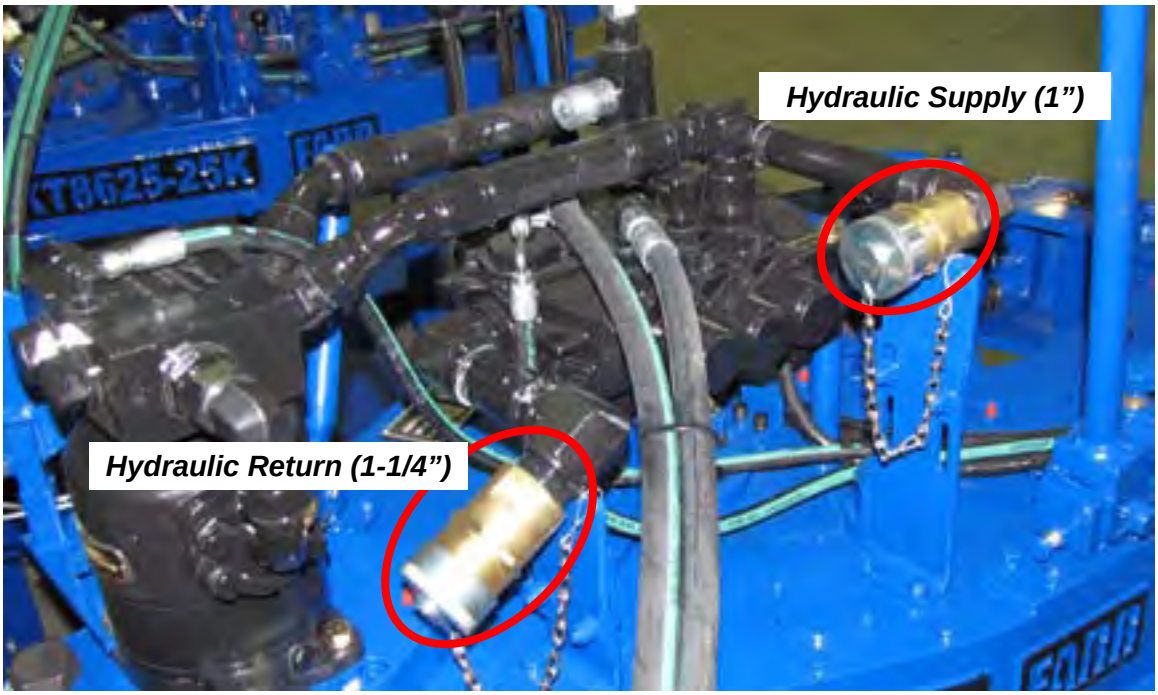


ILLUSTRATION 2.F.1: HYDRAULIC CONNECTIONS 01

These hose couplings are self-sealing, and care should be taken to ensure complete engagement to prevent partial closure of the check valve in the coupling. Ensure that the nut (female) side is completely made up onto the male connector - there is a line on the male fitting that indicates complete make-up. Snug the female fitting right up to the line.

Hydraulic Connections (continued):

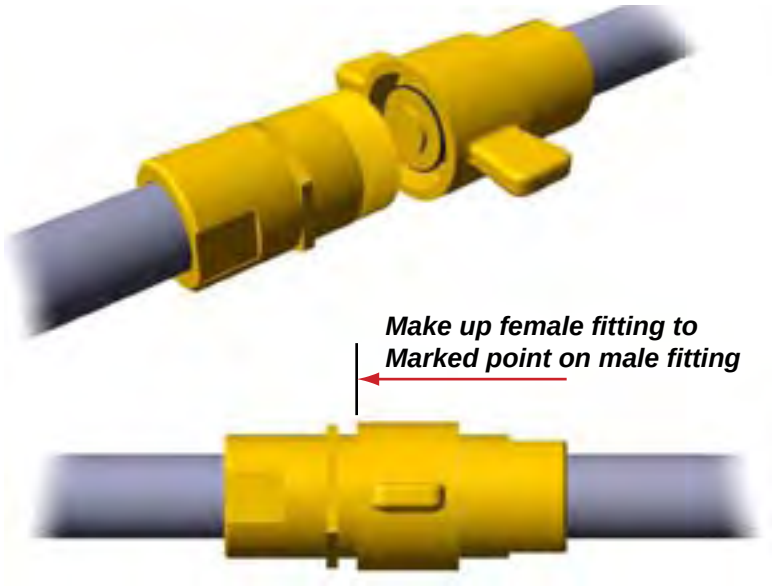


ILLUSTRATION 2.F.2: HYDRAULIC CONNECTIONS 02

A CLEARLY IDENTIFIED REMOTE POWER PACK EMERGENCY STOP MUST BE INSTALLED IN THE IMMEDIATE VICINITY OF THE TONG OPERATOR.

Inspect these connections upon activation of the power unit. Leaking components must be repaired before releasing the tong to the operational environment. Deactivate the power unit and de-pressurize the hydraulic system according to the procedure in Section 3.D. Disconnect the main hydraulic connections and inspect all four connectors (two male, two female) for damage or debris. If the connectors cannot be cleaned or easily repaired, McCoy recommends replacement of the leaking connector. Note that damage to one of the connectors may have caused damage to its mate.

Turn off power unit and depressurize hydraulic system before disconnecting the main hydraulic lines under normal working conditions. See Section 3.D for hydraulic system depressurization. McCoy recommends placing protective caps over the exposed connectors to protect them from water and impact damage.

ALWAYS TURN OFF HYDRAULIC POWER AND DEPRESSURIZE HYDRAULIC SYSTEM BEFORE DISCONNECTING MAIN HYDRAULIC LINES.

G. TONG JAW AVAILABILITY & INSTALLATION

1. Jaw Availability

The following table lists all jaw die kits that are available as standard stocked sizes for this model of tong. McCoy Drilling & Completions | Farr offers a good selection of standard jaw sizes. However, please note that McCoy can custom-engineer and manufacture any size of jaw within the range of the tong. Jaw systems are available to allow use of die inserts intended for specialized applications. Call our sales office for information on jaw and die systems designed for higher or lower grip, or non-marking applications.

The table lists standard contoured, flat and wraparound die inserts that are available as spare parts. However, a wide variety of diamond-tooth, GRITFACE®, and wrap-around fine-tooth dies are available for specialized applications. Please refer to our website for complete information:

http://www.mccoyglobal.com/dies-inserts

USE OF ALUMINUM DIES IS FORBIDDEN ON CE-MARKED EQUIPMENT

STANDARD JAW DIE KITS		
Description	**Part Number**	**Weight (Per Single Jaw)**
2.062" Jaw Die Kit	1050-JDK-100 [A]	18 lbs / 8.2 kg
2-3/8" Jaw Die Kit	1050-JDK-105 [B]	18 lbs / 8.2 kg
2-7/8" Jaw Die Kit	1050-JDK-110 [C]	18 lbs / 8.2 kg
3-1/8" Jaw Die Kit	1050-JDK-112 [D]	18 lbs / 8.2 kg
3-3/8" Jaw Die Kit	1050-JDK-114 [D]	18 lbs / 8.2 kg
3-1/2" Jaw Die Kit	1050-JDK-115 [D]	18 lbs / 8.2 kg
4" Jaw Die Kit	1050-JDK-120	18 lbs / 8.2 kg
4-1/2" Jaw Die Kit	1050-JDK-130	19 lbs / 8.6 kg
4-3/4" Jaw Die Kit	1050-JDK-132	18 lbs / 8.2 kg
5" Jaw Die Kit	1050-JDK-135	17 lbs / 7.7 kg
5-1/2" Jaw Die Kit	1050-JDK-140	18 lbs / 8.2 kg
5-3/4" Jaw Die Kit	1050-JDK-142	17 lbs / 7.7 kg
6" Jaw Die Kit	1050-JDK-143	16 lbs / 7.2 kg
6-1/2" Jaw Die Kit	1050-JDK-144	15 lbs / 6.8 kg
6-5/8" Jaw Die Kit	1050-JDK-145	15 lbs / 6.8 kg
7" Jaw Die Kit	1050-JDK-150	14 lbs / 6.4 kg
7-5/8" Jaw Die Kit	1050-JDK-155	13.5 lbs / 6.1 kg
7-3/4" Jaw Die Kit	1050-JDK-160	12.5 lbs / 5.7 kg
8-5/8" Jaw Die Kit	1050-JDK-165	13 lbs / 5.9 kg
A - Uses contoured insert PN 12-0002		
B - Uses contoured insert PN 12-0004		
C - Uses contoured insert PN 12-0007		
D - Uses contoured insert PN 12-0011		
All other jaw die kits use flat die PN 13-0008-314-0		

2. Jaw / Jaw Die Removal

JAWS MAY PRODUCE METAL SLIVERS. WEAR STURDY GLOVES WHEN REMOVING AND INSTALLING JAW DIE KITS.

The tong jaws will often require removal to change jaw size or replace worn jaw die inserts. Open the tong door to disable tong rotation (rotation is inhibited by safety door systems). Support the jaw being removed from the bottom, and use a wrench to loosen and remove the jaw pivot bolt. Slide the jaw away from the rotary gear towards the centre of the cage plate assembly, and lift clear of the tong (see Illustration 2.G.1 next page). Repeat for the other jaw.

DO NOT ACCESS ROTATING COMPONENTS UNLESS HYDRAULIC POWER SUPPLY HAS BEEN DEACTIVATED OR ISOLATED.

ILLUSTRATION 2.G.1: JAW REMOVAL

Once the jaw has been removed, extract the die keeper screws and remove the dies by tapping dies lightly with a hammer. Replace the dies, tapping them into place if necessary, and replace the keeper screws.

Tong jaws are clearly marked with the size. Ensure the jaw to be installed is the proper size for the pipe to be run. Over-sized or under-sized jaws may result in jaw slippage, or cause the jaws to leave the end of the cam surface on the inside of the rotary gear. Additionally, incorrectly sized jaws will cause the pipe to be off-centre relative to the backup, resulting in eccentric rotation and potential pipe thread damage.

Use of jaws not manufactured by McCoy is not recommended, and may result in jaw slippage jaw failure, or damage to the camming surfaces of the rotary gear.

ENSURE JAWS TO BE INSTALLED ARE THE CORRECT SIZE. USE OF JAWS NOT SUPPLIED BY MCCOY MAY CAUSE JAW SLIPPAGE OR FAILURE, AND MAY RESULT IN DAMAGE TO THE TONG. THE USE OF REDUCER DIES IS NOT RECOMMENDED.

H. TONG RIG-UP & LEVELING

1. Suspension & Restraint

Suspend the tong from a location as near to the centre of the drill rotary as possible, and from a location high enough on the mast to ensure easy handling. The lower the point from which the tong is suspended, the more effort will be required to move the tong to and from the connection point.

The suspension line may be extended over a pulley and balanced by a counterweight equal to the weight of the tong, or simply tied off in the derrick to form a dead line. When using a dead line arrangement it is necessary to use a FARR® spring hanger assembly (see specification page for recommended spring hanger). This spring hanger compensates for the downward movement of the casing as the thread is made-up, and imparts additional force to the suspension cable:

- *a "single spring" hanger typically applies 420 lbs. (191 kg.) to the suspension line for every inch of thread made up*
- *a "double spring" hanger typically applies 840 lbs. (382 kg.) to the suspension line for every inch of thread made up*

If you do not know which specific spring hanger is in use, check the specification page in this manual for information on the recommended spring hanger for this application. McCoy Drilling & Completions will not guarantee or specify spring hangers other than what has been supplied by McCoy.

Many applications use a lift cylinder for adjusting the height of the tong. Ensure the weight of the lift cylinder is known if it has not been included in the total weight of the tong.

All forces upon the suspension line must be considered when calculating necessary strength of the suspension line. The weight of the tong, the weight of the lift cylinder, the weight of the spring hanger, and the force imparted on the suspension line by the spring hanger must all be added together in order to arrive at the total force supported by the suspension line. Select your suspension line based upon the total force and the margins of safety dictated by the policies of your company and by established engineering practices. Ultimately, calculating the force on the suspension line and selection of the suspension line is the complete responsibility of the customer.

Use of dual backup (snub) lines of strength sufficient to withstand the linear force imparted by the maximum rated torque of the tong is integral to ensuring safety on the drill floor. Use of snub lines of less than sufficient strength poses a significant risk of injury to personnel. Calculate the force on the snub lines by dividing the maximum torque of the tong by the tong's torque arm (expressed in feet). For example, a 25,000 lbs.-ft. tong with a 36 inch (3 ft.) torque arm will generate 8333- lbs. of force against the snub line. Select your snub lines and attachment points based upon the total force and the margins of safety dictated by the policies of your company and by established engineering practices. Ultimately, calculating the force on the snub line and selection of the snub line is the complete responsibility of the customer.

Snub lines must be securely connected to the rear of the tong, and tied off to a suitable anchor. One snub line must be secured to the load cell, which is then secured to the rear of the tong. The side of the tong the load cell connects to is dependant upon whether make-up or break-out activities are underway. To ensure accurate torque measurement, the torque measurement line must be connected perpendicular to the lengthwise axis of the tong, and perpendicular to the hang line (see illustrations 2.F.1 and 2.F.2). Connect the second snub line on the opposite side of the load cell, perpendicular to the lengthwise axis of the tong and perpendicular to the vertical. Installed snub lines should have as little slack as possible when not under load.

When placing tong on the drill floor ensure the surface is level and sturdy enough to support the tong without the risk of toppling.

MCCOY DRILLING & COMPLETIONS ACCEPTS NO RESPONSIBILITY FOR DESIGNING AND SELECTING AN ADEQUATE SUSPENSION AND RESTRAINT SYSTEM FOR YOUR DRILLING EQUIPMENT. FAILURE TO FOLLOW THE INSTRUCTIONS PROVIDED IN THIS SECTION MAY RESULT IN SERIOUS INJURY TO THE OPERATOR.

ALL SELECTED FASTENERS, SHACKLES, CLAMPS, ETC. USED FOR CONSTRUCTING THE SUSPENSION AND SNUB LINES MUST BE RATED FOR THE CALCULATED FORCES.

Suspension & Restraint (continued):

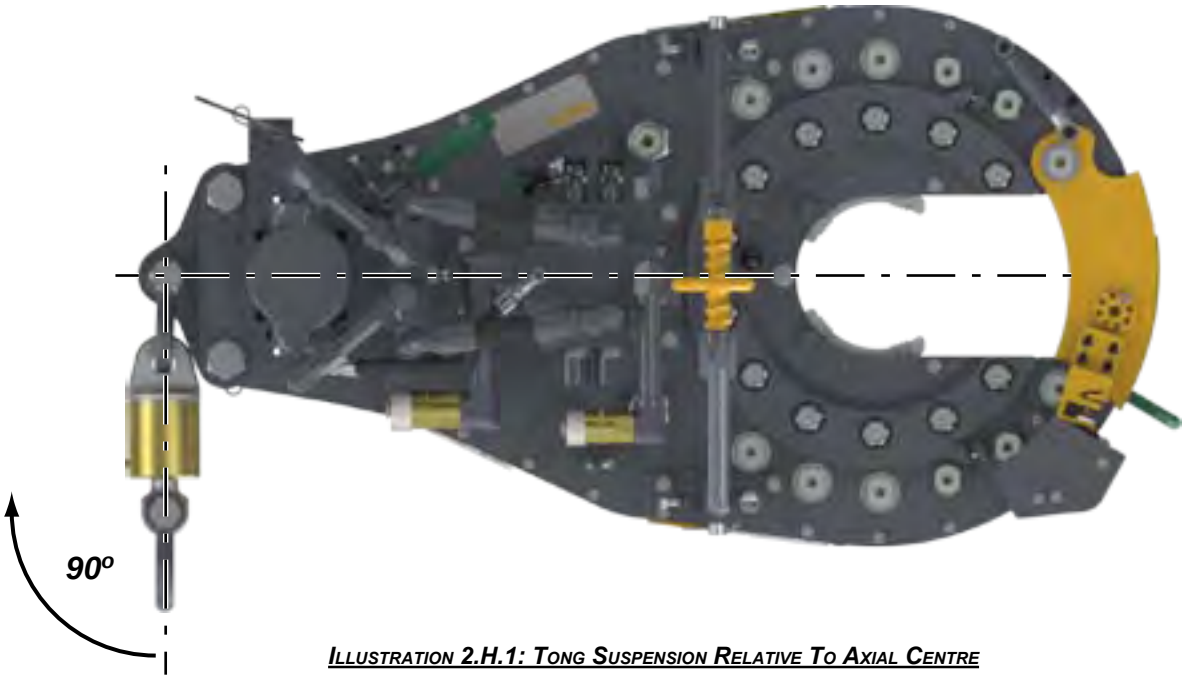


ILLUSTRATION 2.H.1: TONG SUSPENSION RELATIVE TO AXIAL CENTRE

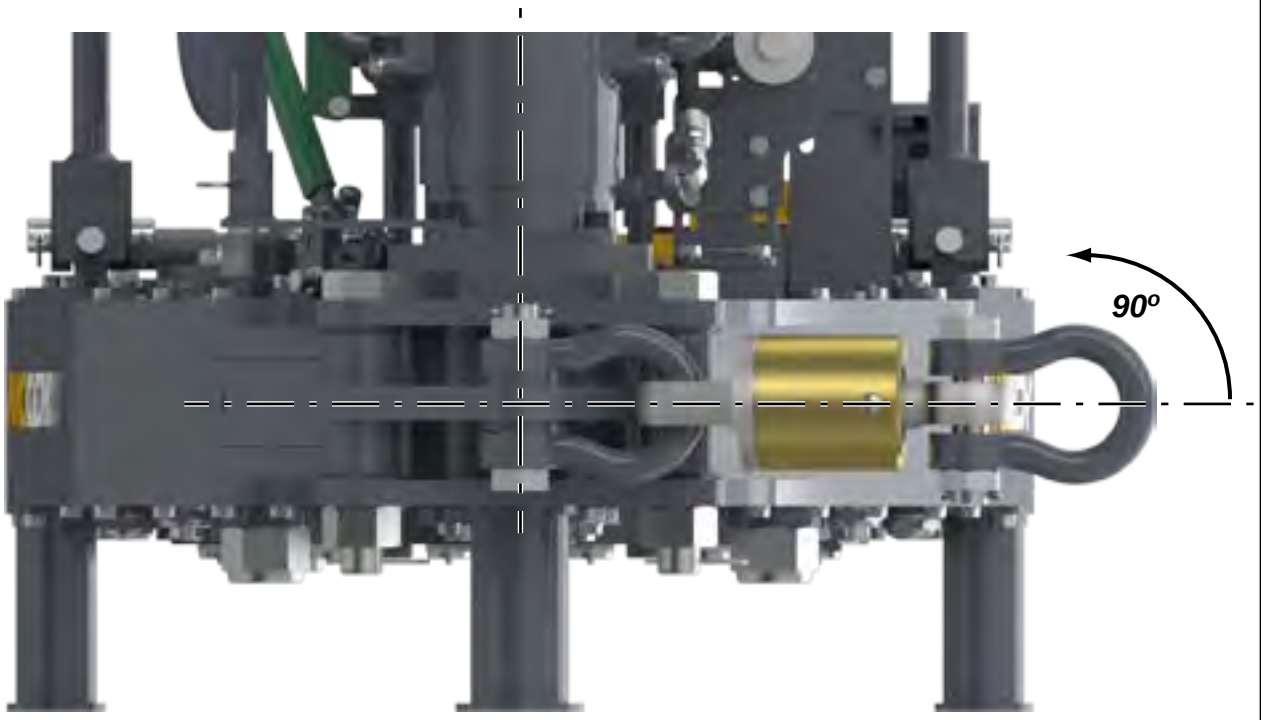


ILLUSTRATION 2.H.2: TONG SUSPENSION RELATIVE TO VERTICAL CENTRE

2. Tong Leveling

The tong must be leveled side-to-side and front-to-rear before placing into service. We have provided the following guidelines for assisting you when leveling your tong.

i. Place a level axially (side to side) across the tong, ensuring that it is parallel with the surface of the tong. Use a thin wrench on the flat of the adjusting helix to rotate the helix, forcing the lift link to move towards the outer supports of the sling. The 3/4" nylock nut on the pin may have to be slightly loosened to allow the helix to rotate. Adjust the helix until the level shows that the tong is level side-to-side.

Tong Leveling (continued):

FAILURE TO PROPERLY LEVEL TONG MAY RESULT IN JAW SLIPPAGE OR FAILURE OF JAW COMPONENTS

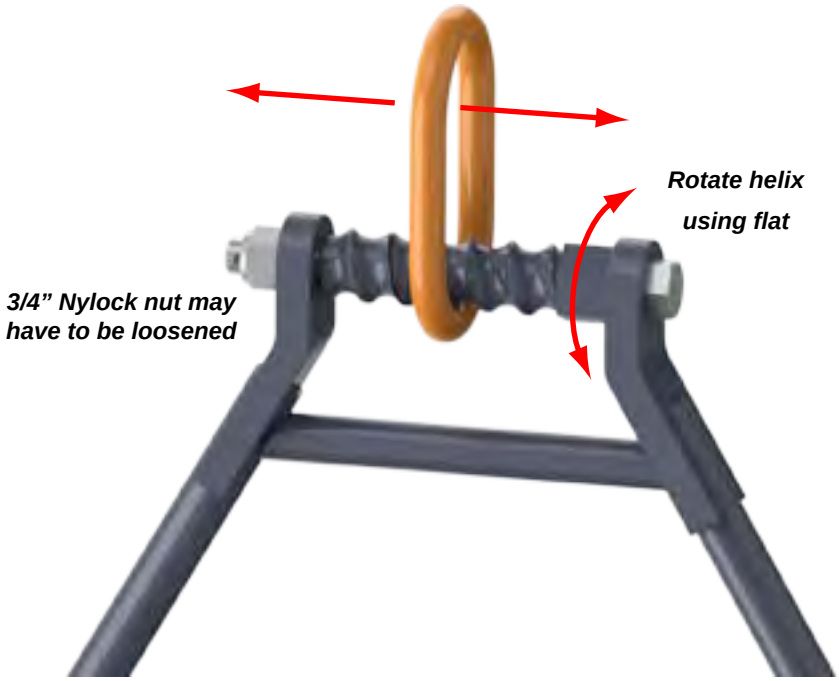


ILLUSTRATION 2.H.3: TONG LEVELING (SIDE-TO-SIDE)

ONLY USE THE MASTER LINK TO SUSPEND THE TONG ASSEMBLY. THE RIGID SLING IS DESIGNED TO BE USED FOR VERTICAL LIFTING ONLY.

ii. *Place a level lengthwise (front to back) along the tong, ensuring that it is parallel with the surface of the tong. Loosen the 1/2" jam nuts on the adjusting bolts on rigid sling brackets. Completely loosen the adjusting bolts. Turn each adjusting bolt equally until tong hangs level front-to-back. Lock adjusting bolts in place with the jam nuts.*

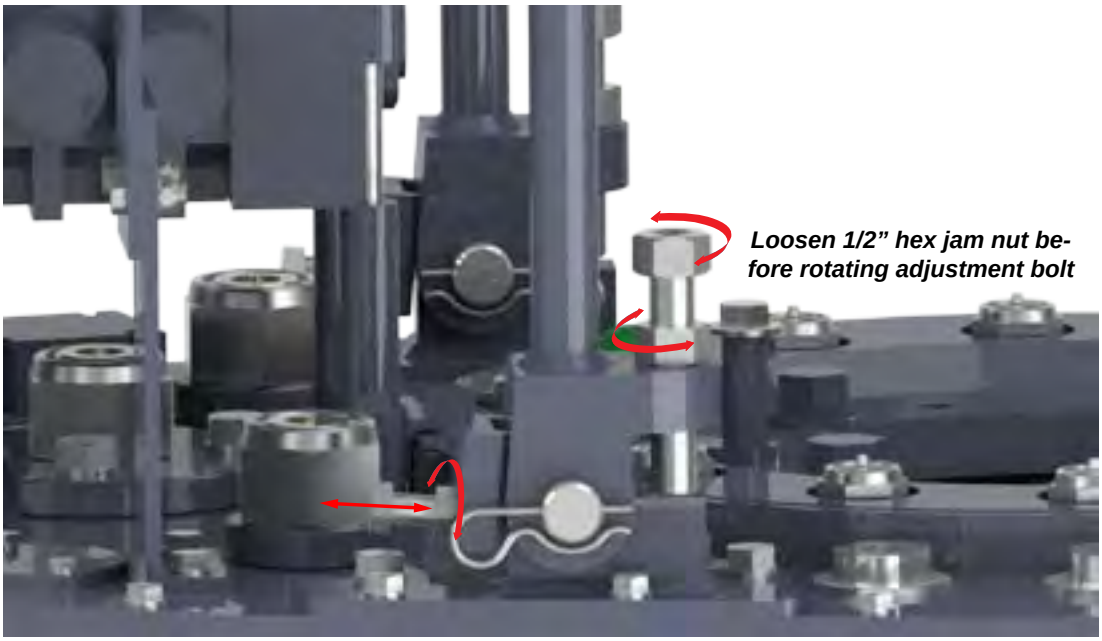


ILLUSTRATION 2.H.4: TONG LEVELING (FRONT-TO-REAR)

I. TONG OPERATION

1. Operator Training

Many companies set qualification standards that must be met before equipment may be operated without supervision. McCoy Drilling & Completions recommends operator training, which typically consists of operation of the equipment under the supervision of a trained equipment operator until a satisfactory level of competence is achieved. Typical operator training should include:

- *Introduction to and general description of equipment*
- *Technical specifications and performance data*
- *Operating instructions*
- *Control systems and interlocks*
- *Operating hazards*
- *Checks and inspections*

2. Operator Safety

McCoy recommends that a hazard assessment of the work area be performed by a designated safety representative before commencing operations. A designated safety representative is responsible for verifying that all operators have adequate equipment and safety training.

The safety door system is the primary device protecting the tong operator and nearby personnel from the rotary gear. Confirm the correct operation of the safety door before every job. Never disable the safety door device.

Inspect anti-tamper devices on safety door components before beginning job. Equipment showing signs of tampering on any safety system must be immediately removed from service and tested. Anti-tamper devices must be restored before allowing equipment to be released to an operating environment.

The area surrounding the tong operating area must be clutter-free and free from tripping hazards, or protruding objects that may snag hydraulic hoses on the tong, backup, lift cylinder, or torque measurement system. Operating surface or drill floor must be kept free of slipping hazards like grease, oil, water, etc.

Adequate lighting of the work area is required. All warnings, labels, gauges, and signs must be clearly visible

The components of the tong commonly manipulated or requiring control input are painted green, and are safe for continuous handling. Areas painted yellow are designated as hazardous areas, and contact with those areas must be avoided during operation. Always wear all personal protective equipment (PPE) specified by your company's HSE policy, and follow all of your company's safety guidelines.

ALWAYS WEAR APPROVED PERSONAL PROTECTIVE EQUIPMENT (PPE) WHEN OPERATING HYDRAULICALLY-POWERED EQUIPMENT.

Ensure hydraulic power is deactivated and tong hydraulics are de-pressurized before disconnecting the main hydraulic lines. McCoy recommends depressurizing the tong hydraulic system before connecting or disconnecting quick-connect fittings.

DEPRESSURIZE EQUIPMENT BEFORE DISCONNECTING MAIN HYDRAULIC LINES.

3. Valve Operation

4-way proportional valves control operation of hydraulic devices on the tong assembly such as hydraulic motors and cylinders. When any one valve is "centered" or in the detent position, there is no hydraulic output from the valve. When the valve is pushed forward there is an effect, and when the valve is pulled back, there is an opposite effect. These valves feature proportional control, which means that further extension of the valve handle (thereby further opening the valve orifice) results in proportionally higher hydraulic output to the controlled device.

The following illustrations demonstrate the type and effect of the hydraulic valves with which this tong is may be equipped.

TONG MOTOR

This is a proportional valve. Pushing the valve handle forward will cause the tong motor to rotate in a clockwise direction (as seen from the top of the tong). This is the desired direction of rotation for making up a joint. Pulling the valve handle in the opposite direction results in counter-clockwise rotation, which is the desired direction of rotation for breaking out a joint. Releasing the valve handle will cause the tong to immediately stop rotation.

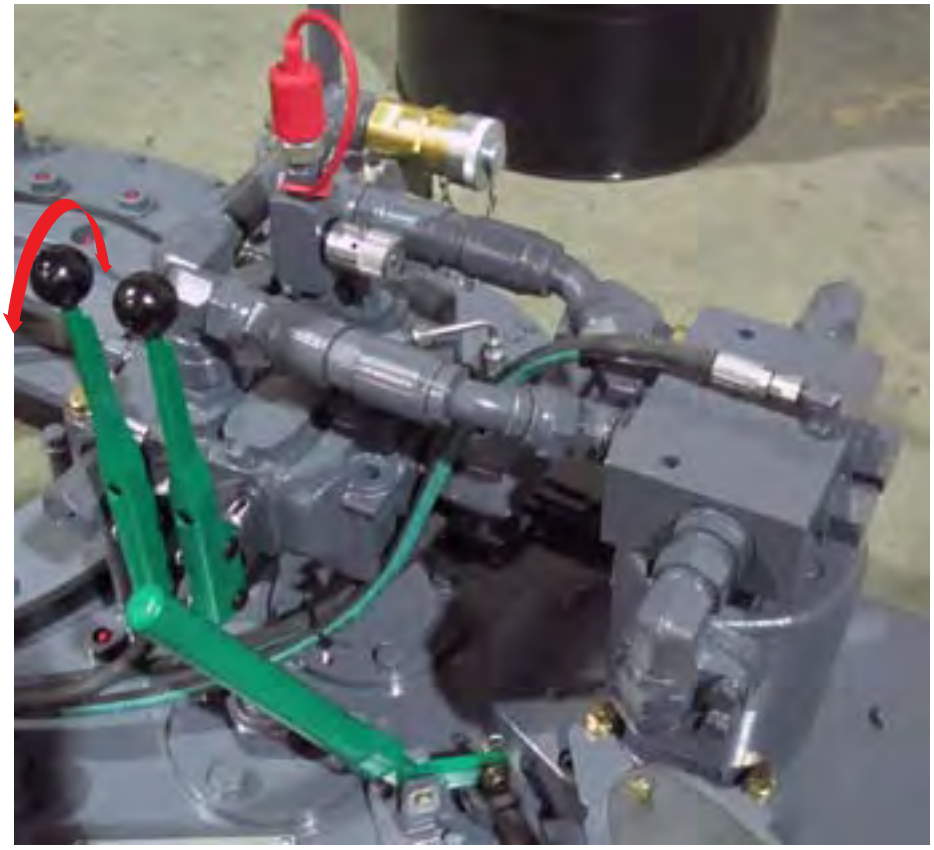


ILLUSTRATION 2.I.1: TONG MOTOR CONTROL VALVE

LIFT CYLINDER CONTROL VALVE

This is a direct-acting valve. Pulling out on the valve handle will cause the lift cylinder to lift the tong vertically. Pushing in on the valve handle will cause the lift cylinder to lower the tong. Releasing the valve handle will immediately stop the lifting or lowering action.

CE *Pushing on the lift cylinder control valve handle (toward the center of the tong) will cause the equipment to lift, while pulling on the lift cylinder control valve handle (toward the operator) will cause the equipment to lower. This valve handle action applies to all CE-marked tongs and is irregardless of control valve bank orientation.*

LIFT CYLINDER NEEDLE VALVE (See illustration 2.I.2)

This needle valve regulates hydraulic fluid flow to the lift cylinder. Closing the needle valve (rotating the knob clockwise) will increasingly restrict the flow rate of the fluid, resulting in slower actuation of the cylinder in both directions (lifting & lowering).

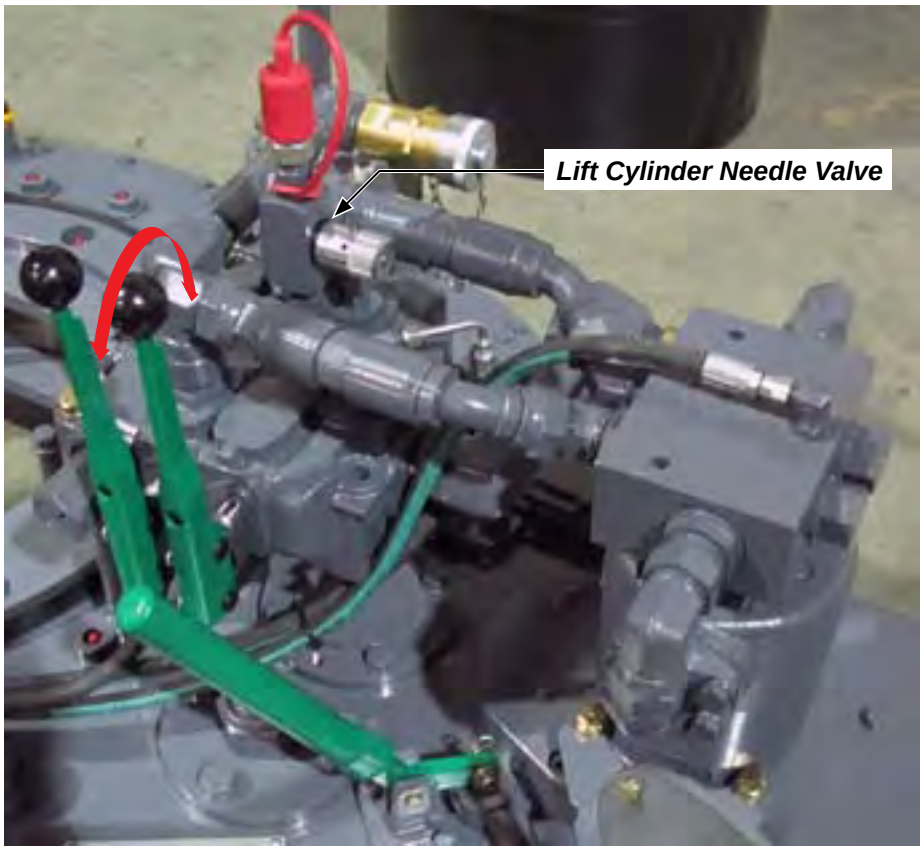


ILLUSTRATION 2.I.2: TONG LIFT CYLINDER CONTROL VALVES

4. *Shifting Gears*

The shifting shaft has three "detent" positions identifying the low speed/high torque position, the "neutral" or free-spinning position, and the high speed/low torque position. The detent strength may be adjusted by releasing the locknut on the detent tube and increasing or relaxing pressure on the detent spring. Ensure the locknut is tightened once the desired detent pressure has been set.

To shift to the high-speed gear, move the shifting handle DOWN from neutral position. To shift to the low-speed gear, move the shifting handle UP through the neutral detent to its HIGHEST position. Note that the high clutch gear or the low clutch gear may not be exactly aligned when shifting, so the operator may need to "bump" the motor control handle slightly to turn the main clutch gear shaft and shifting collar into alignment. The most effective way of achieving this is to apply a small amount of pressure on to the gear shift lever in the direction you want to shift the tong, ensuring the shifting collar will "catch" when the main clutch gear aligns with either the high or low clutch gear (see Illustration 2.I.3 next page)

DO NOT SHIFT TONG WHILE ROTATING THE MOTOR AND CAGE PLATE. CATASTROPHIC GEAR TRAIN FAILURE MAY RESULT.

Shifting Gears (continued):

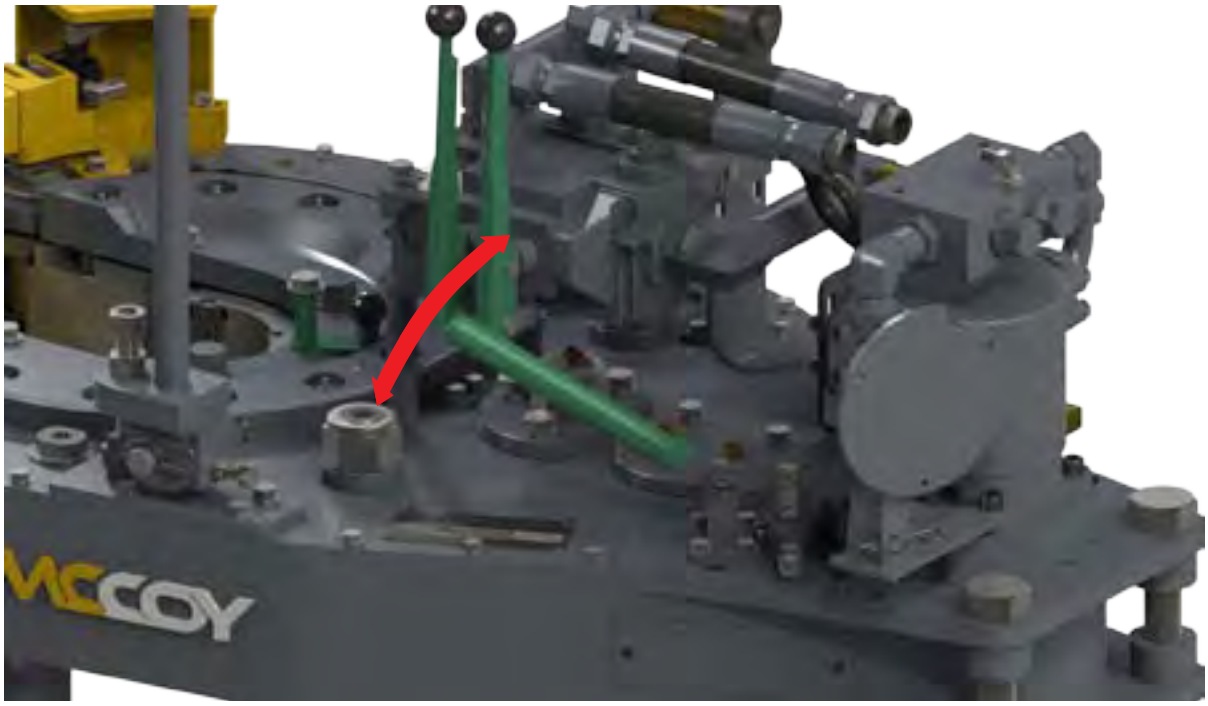


ILLUSTRATION 2.I.3: TONG MANUAL SHIFTER

5. Pre-Operational Checks

McCoy recommends that the following pre-operating tests be performed prior to releasing the tong assembly to a operational environment:

a. Connect the tong to a hydraulic power source in a controlled environment. Ensure the power unit's operating parameters are within the specifications as identified on Pg. 1.3. Ensure the hydraulic connections from the power unit are properly and securely made up (see Section 2.E). Do not neglect to connect the motor drain line.

b. Start the power unit as specified by the power unit operator's manual. Open the Bypass Valve on the hydraulic system, and inspect all pressure and return line hose connections to ensure correct and secure installation. A restriction in the pressure supply hose will result in high pressure within the power unit hydraulic system, which will activate the hydraulic governor and increase the engine speed to as high as maximum RPM. A restriction in the return line will result in high pressure within the power unit and the tong hydraulic system, causing engine speeds as high as maximum RPM, and possible failure of the motor seal.

A CLEARLY IDENTIFIED REMOTE POWER PACK EMERGENCY STOP MUST BE INSTALLED IN THE IMMEDIATE VICINITY OF THE TONG OPERATOR.

c. Allow hydraulic system to warm by circulating fluid for about 10 minutes, then slowly close the bypass valve to allow hydraulic fluid to circulate through the hoses and tong. Ensure circulating pressure does not exceed 200 psi.

d. Inspect all hydraulic hoses and connections on the tong. Immediately correct any hydraulic fluid leaks.

e. Inspect all gauges. Replace leaking or cracked gauges, or any gauge not registering a reading.

f. Confirm that all load-bearing pins and R-clip retainers are installed and in good condition (rigid sling pins, lift cylinder pins).

g. Confirm all hydraulic hoses (with the exception of the supply & return to the backup) are securely fastened to the tong, and are not in contact with the cage plate or creating a snagging hazard.

h. Ensure the tong door is securely closed before rotating tong.

DOOR MUST BE CLOSED AND SECURELY LATCHED BEFORE TONG ROTATION IN ORDER TO ASSURE THE SAFETY OF OPERATING PERSONNEL.

Pre-Operational Checks (continued):

i. Shift the tong to low gear (see Section 2.I.3) and rotate the tong slowly forward for approximately a minute. Stop the tong and then reverse the rotation direction for approximately another minute. Stop the tong, shift to high gear, and operate in high gear for approximately another minute. Stop the tong and rotate in the opposite direction in high gear for approximately another minute. If at any time abnormal operation is suspected (surging, grinding, squealing, or other noises deemed to be unusual, or failure to operate) discontinue operation of the tong and contact McCoy Drilling & Completions immediately.

j. Re-inspect all hydraulic lines and connections on the tong, and correct all leaks.

k. The safety door system is the prime protective measure separating the operator from the rotary gear, and must be in working condition when operating tong. Carefully inspect the safety door components, and test the operation of the safety door using the following procedure:

i. Keep non-essential personnel clear of the unit under test. This test procedure will only include two people: one to run the control valve and one to operate the door.

ii. Ensure the tong door is securely closed.

iii. Shift to LOW gear.

iv. Begin rotating the tong (direction of rotation is not important).

v. Open the tong door while the rotating the tong. The tong must immediately and completely stop rotating as soon as the door is opened.

vi. Continue to apply rotation control, and open & close the door throughout its complete range. Slowly close the door until it latches. Rotation must not begin until the door is completely closed and securely latched.

If the safety door does not operate as designed, the safety door switch may require adjustment, or further troubleshooting of the safety door system may be required. See Section 3.F.4 for safety door switch adjustment procedures, and Section 4.D for safety door troubleshooting instructions.

The safety door switch is protected from impact by a sturdy metal guard, painted yellow. This guard must be inspected before each use of the tong. All components of the guard must be in place, and all fasteners securing the guard must be intact and tight. Ensure wire ties (where applicable) on safety door components are present and secure, and do not show signs of tampering.

DO NOT OPERATE TONG WITH A MALFUNCTIONING OR NON-OPERATING SAFETY DOOR SYSTEM.

6. General Comments

a) Position rotary gear in contact with both idler gears when making up or breaking out joints or collars when torque in excess of 50% of the rated torque is required.

b) When making-up integral (shouldered) joints, it is essential to make up the last turn of the threads in low gear. This reduces the tendency of an instant stop or a sudden increase in torque, which induces extremely high stress upon the gear train.

c) DO NOT employ the "snap break" method of breaking-out joints when pulling a string. By definition, the "snap break" method is a procedure used by some operators to break out connections, accomplished by leaving slack in the "jaw-pipe" engagement, and then quickly pulling the throttle valve control lever allowing the tong to snap into its loaded or high torque condition. The extremely high stress placed on the gear train frequently causes gear breakage.

DO NOT USE THE "SNAP BREAK" METHOD TO BREAK OUT JOINTS

J. MAKING AND BREAKING CONNECTIONS

THESE OPERATING PROCEDURES ASSUME THE USER HAS PROPERLY SET UP AND PREPARED THE EQUIPMENT FOR OPERATION AS PER SECTIONS 2D, 2E, AND 2F OF THIS MANUAL.

Set up and prepare your equipment for operation as per Section 2 of this manual Refer to the following sections:

- *2.D - Lift Cylinder Installation*
- *2.F - Hydraulic Connections*
- *2.G - Tong Jaw Installation*
- *2.H.1 - Tong Rig-up and Leveling (Suspension)*
- *2.H.2 - Tong Rig-up and Leveling (Leveling)*

Your tong and backup assembly should be properly suspended, connected to a hydraulic power source, and ready to make or break connections at this point.

1. Making A Connection

a) *Ensure hydraulic power supply to the tong is energized. The master link on the rigid sling must be used to suspend the tong. Do not suspend the tong directly from the rigid sling.*

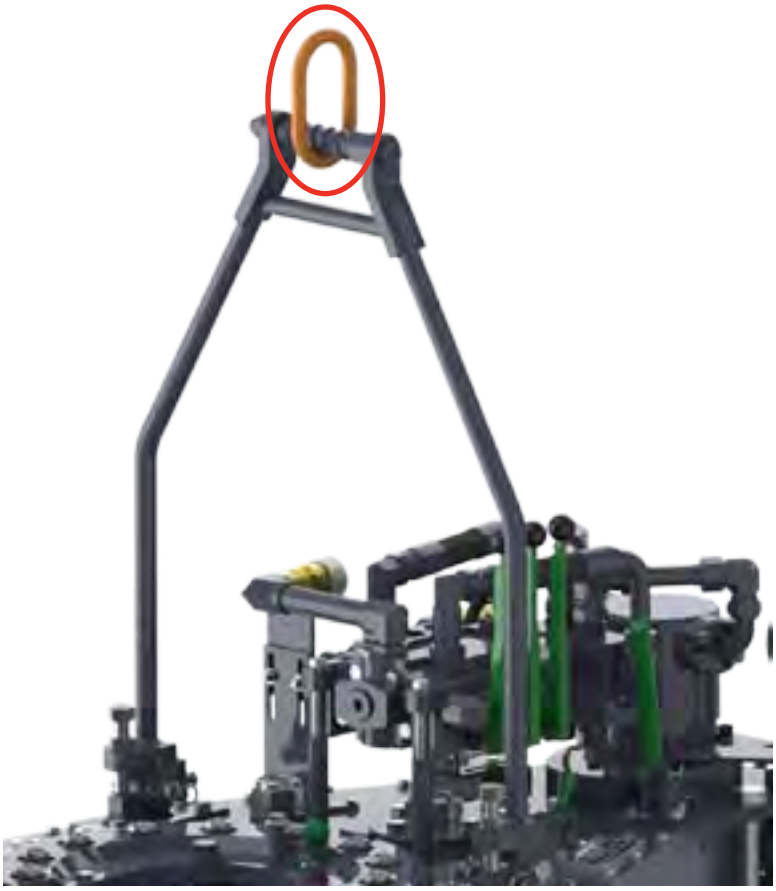


ILLUSTRATION 2.J.1: MASTER LIFTING LINK

THE MASTER LINK MUST ALWAYS BE USED TO SUSPEND THE TONG ASSEMBLY

b) *Ensure the backing pin is in the "make-up" position. From the front of the tong, the backing pin correctly configured for makeup will be in the 10 o'clock position (see Illustration 2.J.2 next page). If it is not, simply lift up and place in the correct position (see Illustration 2 next page). The cage plate opening must be aligned with the door opening when setting the backing pin position.*

Making A Connection (Continued)

ILLUSTRATION 2.J.2: BACKING PIN SET TO "MAKE-UP" POSITION

c) *Ensure the load cell and snub line(s) are properly configured for making up connections. A "snub line" is a length of wire rope that connects the rear of the tong body to a sturdy anchor on the drill floor (see Section 2.F.1). The snub line prevents the tong body from spinning in the opposite direction of the cage plate when torque begins to build in the joint. Farr Canada Corp. recommends using two snub lines when running the equipment to eliminate uncontrolled movement in either rotational direction. The snub line(s) must be rated for the applied torque plus whatever safety margins stated by your own operating policies. The snub line connection point on the drill floor must be sturdy enough to absorb all applied forces when making up the joints. When making up joints the load cell must be connected to the driller's side of the tong, which is the left side of the tong as seen from the rear. For accurate torque measurement the snub line between the tong body and the anchor must be perpendicular to the vertical, and perpendicular to the centre-line of the tong.*

d) *Actuate the lift cylinder control valve to lift the assembly from the drill floor. Pulling on the valve handle toward the operator will retract the lift cylinder to lift the assembly (see Illustration 2.J.4 below). Note that rig personnel are required to stabilize the tong and backup as it is being lifted so it does not swing and collide with other rig equipment.*

CE *Pushing on the lift cylinder control valve handle (toward the center of the tong) will cause the equipment to lift. This valve handle action applies to all CE-marked tongs and is irregardless of control valve bank orientation.*

RIG PERSONNEL MUST STABILIZE THE TONG AS IT IS LIFTED FROM THE DRILL FLOOR

Making A Connection (Continued):

ILLUSTRATION 2.J.3: LIFT CYLINDER CONTROL - RAISE

e) *Grasp the tong door handle and pull the door to release the latch and open the door. (See Illustration 2.J.4). Opening the tong door will activate the safety door system and prevent rotation of the cage plate.*

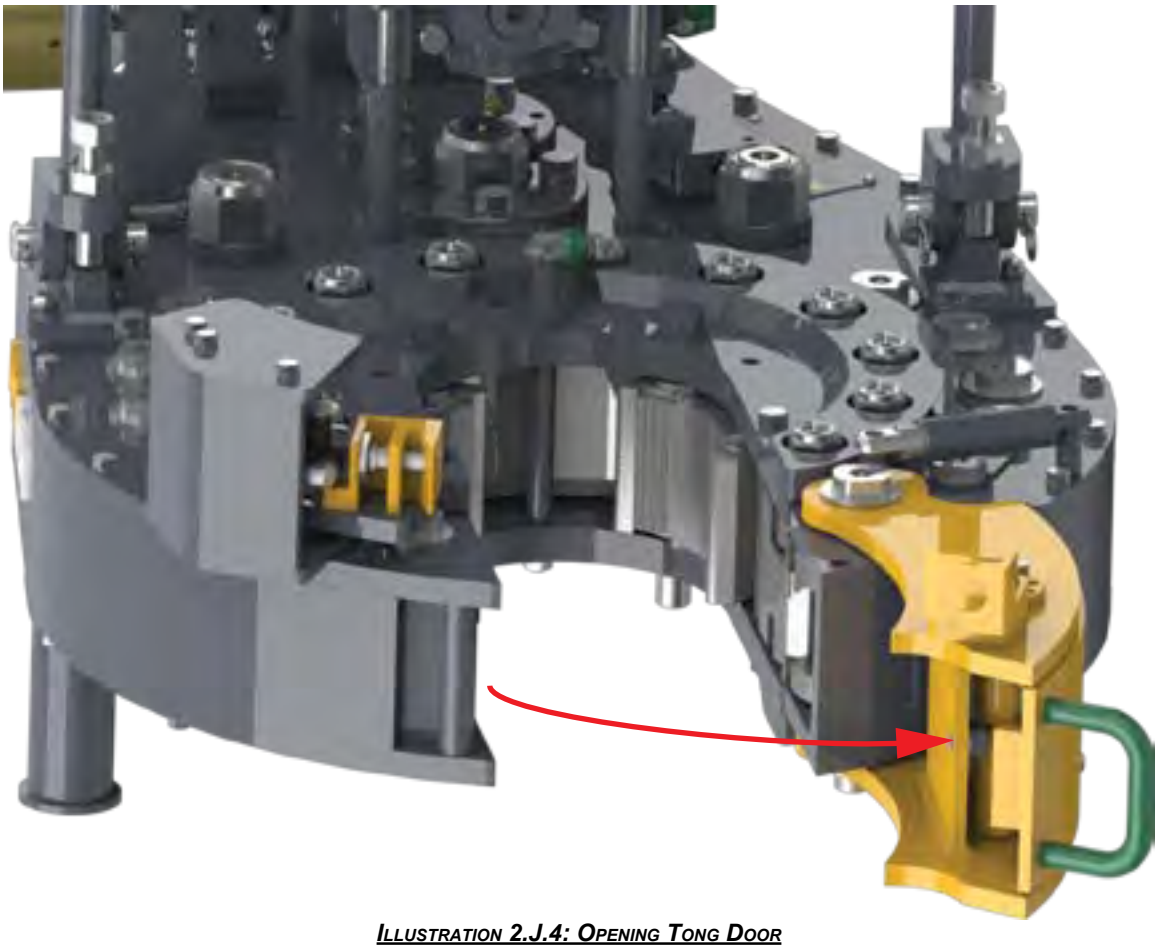


ILLUSTRATION 2.J.4: OPENING TONG DOOR

Making A Connection (Continued):

f) Manually engage the threads of the tubing connection being made up. Ensure threads are not cross-threaded.

g) Move the tong on to the pipe above the tubing joint. Use the lift cylinder to ensure the tong jaws are at the correct location above the connection joint.

h) Firmly close the tong door against the latch post.

i) Begin rotation with the tong in high gear and the tong motor set to high speed (high speed/low torque). See Section 2.I.2 to set the tong motor to high speed, and Section 2.I.3 to properly set the tong to high gear. Do not shift gears while the tong is rotating.

SHIFTING TONG WHILE ROTATING THE MOTOR AND CAGE PLATE MAY RESULT IN CATASTROPHIC GEAR TRAIN FAILURE

j) Push the motor control valve toward the tong to rotate the cage plate in the make-up direction.

ILLUSTRATION 2.J.5: MOTOR CONTROL - MAKE-UP

k) Push the rotation control handle toward the centre of the tong once the tong jaws cam on to the tubing This threads the connection together at high speed. As the joint becomes fully made up the increasing torque demand will stall the motor, and displayed torque will increase.

l) Stop rotation, and set motor to low speed and shift to low gear (low speed/high torque - See Section 2.I.2 for instructions for setting motor to low speed, and Section 2.I.3 for shifting to low gear). This will enable the tong to produce adequate torque for making up the joint to specification.

m) Push the rotation control handle all the way in to complete the connection at low speed/high torque. Observe the torque gauge - stop rotation when the specified make-up torque is reached. Reverse the rotation control valve to release the tong jaws from the tubing (see Illustration 2.J.6 next page).

Making A Connection (Continued):

ILLUSTRATION 2.J.6: MOTOR CONTROL - RELEASING JAWS

p) *Align the opening in the rotary gear with the mouth of the tong once the jaws are free. Open the tong door. Note that rig personnel may be required to stabilize the tong as it completely releases from the drill string. Guide the tong away from the string. Push the lift cylinder control valve toward the centre of the tong to lower the equipment to the drill floor if desired.*

CE *Pulling on the lift cylinder control valve handle (toward the operator) will cause the equipment to lower. This valve handle action applies to all CE-marked tongs and is irregardless of control valve bank orientation.*

ILLUSTRATION 2.J.7: LIFT CYLINDER CONTROL - LOWER

p) *Repeat steps "e" through "p" until the desired number of connections are made up.*

2. Breaking A Connection

YOUR TONG SHOULD BE PROPERLY SUSPENDED, CONNECTED TO A HYDRAULIC POWER SOURCE, AND READY TO BREAK CONNECTIONS.

a) *Ensure hydraulic power supply to the tong is energized. The master link on the rigid sling must be used to suspend the tong. Do not suspend the tong directly from the rigid sling. See Illustration 2.J.1.*

b) *Set the backing pin on the tong "breakout" operation. Lift up on the backing pin and rotate it to the "breakout" position, which is 2 o'clock as seen from the front of the tong. The opening in the rotary gear must be aligned with the tong door opening in order to properly set the backing pin (see Illustration 2.J.8).*

ILLUSTRATION 2.J.8: SETTING BACKING PIN TO "BREAK-OUT" POSITION

c) *Ensure the load cell is configured for break-out operation. If torque measurement for break-out is required, connect the load cell to the off-driller's side (the right-hand side as seen from the rear of the tong).*

d) *Connect snub lines to the rear of the tong to arrest uncontrolled rotation of the assembly. The snub lines must be rated for the applied torque plus whatever safety margins stated by your own operating policies. The snub line connection points on the drill floor must be sturdy enough to absorb all applied and potential forces.*

e) *Open the tong door (see Illustration 2.J.4).*

f) *Actuate the lift cylinder control valve to lift the assembly from the drill floor. Pull the valve toward the operator to retract the lift cylinder to lift the assembly (see illustration 2.J.4). Note that rig personnel are required to stabilize the tong and backup as it is being lifted so it does not swing and collide with other rig equipment.*

CE *Pushing on the lift cylinder control valve handle (toward the center of the tong) will cause the equipment to lift. This valve handle action applies to all CE-marked tongs and is irregardless of control valve bank orientation.*

RIG PERSONNEL MUST STABILIZE THE TONG AS IT IS LIFTED FROM THE DRILL FLOOR

g) *Firmly close the tong door against the latch post.*

h) *Rig personnel may be required to stabilize the tong above the connection until the jaws have been clamped shut.*

Breaking A Connection (Continued)

i) Break-out torque is only available when tong motor speed is set to low speed and tong is in low gear. See Section 2.I.2 to set tong to low speed and Section 2.I.3 to shift to low gear. Do not shift gears while the tong is rotating.

SHIFTING TONG WHILE ROTATING THE MOTOR AND CAGE PLATE MAY RESULT IN CATASTROPHIC GEAR TRAIN FAILURE

j) Gently pull the motor control valve toward the operator to cam the tong jaws on to the pipe.

ILLUSTRATION 2.J.9: ROTATION CONTROL - BREAK-OUT

k) Break the connection by pulling the rotation control handle all the way out once the tong jaws cam on to the tubing.

l) Un-thread the connection at high speed by setting the tong motor to high speed and shifting to high gear (see Section 2.I.2 to set motor speed and 2.I.3 to shift to high gear) once the connection is broken.

m) Pull the rotation control handle all the way out to completely un-thread the connection. Reverse the rotation control handle (push toward tong) to release the tong jaws from the tubing.

ILLUSTRATION 2.J.10: USING MOTOR CONTROL TO RELEASE TONG JAWS FOLLOWING BREAK-OUT & UN-THREADING

Breaking A Connection (Continued)

n) Align the opening in the rotary gear with the mouth of the tong once the jaws are free. Open the tong door and guide the tong away from the string, and push the lift cylinder control handle to lower it to the drill floor if desired.

RIG PERSONNEL MUST STABILIZE THE TONG AS IT IS LOWERED TO THE DRILL FLOOR

Pulling on the lift cylinder control valve handle (toward the operator) will cause the equipment to lower. This valve handle action applies to all CE-marked tongs and is irregardless of control valve bank orientation.

ILLUSTRATION 2.J.11: LOWERING TONG USING LIFT CYLINDER CONTROL

o) Use your rig's standard pipe handling procedures to remove and rack the freed tubing strand.

p) Repeat steps "e" through "p" as many times as necessary to break out and un-thread the desired number of connections.

K. EXTREME COLD WEATHER OPERATION PROCEDURES

1) Consult the power unit engine operator's manual for all cold weather operating procedures and precautions.

2) Select gear and bearing lubricants that are compatible with expected climatic conditions.

3) Select hydraulic fluid that is compatible with expected climatic conditions.

4) Allow hydraulic fluid to circulate for approximately 20 minutes after starting the power unit, prior to activating the bypass valve to allow fluid to circulate to tong. If the power unit is equipped with an oil temperature gauge, ensure that the fluid has reached operating temperature as specified by hydraulic fluid data sheet.

5) Allow for adequate drying of moisture (prior to lubricating) when cleaning tong parts in cold weather.

McCoy Completions & Drilling recognizes that minor on-site repairs and modifications are required to maintain peak operating condition of your equipment, or to match your equipment with the operating environment. Examples of minor repairs are

- *replacement of damaged hydraulic hoses and fittings.*
- *replacement of malfunctioning pressure gauges and valves.*
- *replacement of door spring stop cylinders*
- *replacement of fasteners*

Any replaced component must be an identical component supplied by McCoy Completions & Drilling. Replaced fasteners must be Grade 8 or equivalent, or whatever fastener is specified by McCoy.

A. GENERAL MAINTENANCE SAFETY PRACTICES

The practices identified here are intended as a guideline. All personnel are responsible for performing their tasks in a manner that ensures worker, equipment, and environmental safety, and may require taking additional steps that are not identified in this section.

Equipment maintenance shall be performed only by designated qualified maintenance personnel. Wear all personal protective equipment (PPE) specified by your company's HSE policy, and follow all of your company's safety guidelines. Do not begin a maintenance task without the proper tools or materials on hand, or the proper drawings and documentation necessary.

Schedule planned maintenance with operators to avoid conflicts, unnecessary downtime, and the danger of accidental equipment activation. Notify operations when maintenance procedures are complete and equipment functionality is restored and tested.

If on-site maintenance must be performed (in other words, if equipment cannot be transported to a controlled maintenance facility) isolate the location of the maintenance to prevent unaware personnel from inadvertently exposing themselves to a hazard. Use tape, rope, or signage to clearly indicate "off-limits" area.

Replacement of large, heavy individual parts and/or heavy structural components must be performed using an approved lifting device of sufficient lifting capacity. Use care when attaching the lifting device, and safeguard area to avoid endangering personnel or equipment.

All spare parts must meet or exceed OEM specifications in order to maintain equipment integrity, especially protective equipment.

DO NOT PERFORM MAINTENANCE UNTIL TUBULAR CONNECTION EQUIPMENT HAS BEEN COMPLETELY ISOLATED FROM HYDRAULIC POWER

Your equipment uses materials that may be harmful to the environment if improperly disposed of (hydraulic fluid, grease, etc.). Dispose of all materials according to your company's proscribed environmental protection regulations.

B. CLEANING

Clean tong thoroughly cleaned with a good petroleum-based cleaning agent after each job, prior to storage. Farr® recommends that the motor and valve assembly be periodically removed, along with the top tong plate, so that guides, rollers and gears can be properly cleaned (see Section 3.H, Overhaul). Ensure that cleaning solvents and chemicals are captured to prevent environmental contamination, and dispose of all materials according to your company's proscribed environmental protection regulations.

C. PREVENTIVE MAINTENANCE PRACTICES

Regular maintenance programs are necessary, and must be established to assure safe, dependable operation of your Hydraulic Tubular Connection System and to avoid costly breakdown maintenance. The following maintenance procedures provides information required to properly maintain your equipment. Your equipment may require more, or less maintenance depending upon the frequency of use and the field conditions under which your equipment operates. These maintenance procedures are designed for equipment operating at 10°C to 35°C ambient temperature for 10 hours per day. McCoy recommends that the inspection and maintenance procedures in this section be performed as recommended in the maintenance checklists (see Appendices), or in conjunction with your maintenance foreman's experience and best estimate of when your equipment is due for this maintenance.

Manufacturers of purchased components included with your hydraulic tubular connection equipment (for example: motors, valves, etc.) may specify maintenance tasks and intervals over and above what McCoy recommends as part of their recommended procedures. Users of this equipment may choose to perform or ignore these additional tasks at their discretion.

Filtration of the hydraulic fluid must be 10 microns or better. Premature fouling of particulate filters within your prime mover or ancillary hydraulic power unit requires immediate hydraulic fluid laboratory analysis to prevent premature wear of hydraulic system due to high levels of wear metals in the fluid.

McCoy Drilling & Completions recommends tracking all maintenance activity including the lubrication schedule and replacement of hydraulic hoses. This may be a simple as keeping a paper log, or using a software-based maintenance tracking utility. A maintenance log is a valuable tool that can be used for easily retrieving maintenance history or identifying trends that require correction.

D. HYDRAULIC SYSTEM DE-PRESSURIZATION

McCoy Drilling & Completions recommends that the hydraulic system be de-pressurized prior to maintenance on any hydraulic component. Perform the following steps to ensure the dangers posed by hydraulic fluid under pressure are minimized.

ENSURE ADEQUATE CONTAINMENT IS IN PLACE TO PREVENT ENVIRONMENTAL CONTAMINATION FROM RESIDUAL HYDRAULIC FLUID

1) *Rotate the tong to the "open throat" position. Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder*
2) *De-energize the power unit.*
3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
4) *Remove the hydraulic SUPPLY line from the equipment.*
5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Disconnect the hydraulic RETURN line from the equipment.*
8) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES

E. LUBRICATION INSTRUCTIONS

Use a quality multipurpose bearing lubricant that will remain within its viscosity range at expected operating temperatures. In addition, Farr recommends the following lubrication procedure at the completion of each job prior to storage.

McCoy recommends that a liberal coating of grease be applied to the cam surface of the rotary drive gear prior to jaw installation. Also, the clutch inspection plate should periodically be removed, and a liberal coating of grease applied to the clutch, drive gears and shifting shaft.

Coat the jaw pins and rollers with a liberal amount of anti-seize compound when installing new jaw die kits.

1. Cage Plate Cam Followers

Apply grease to the cam followers through the grease fittings recessed into the top and bottom cage plates (thirteen locations top, thirteen locations bottom).

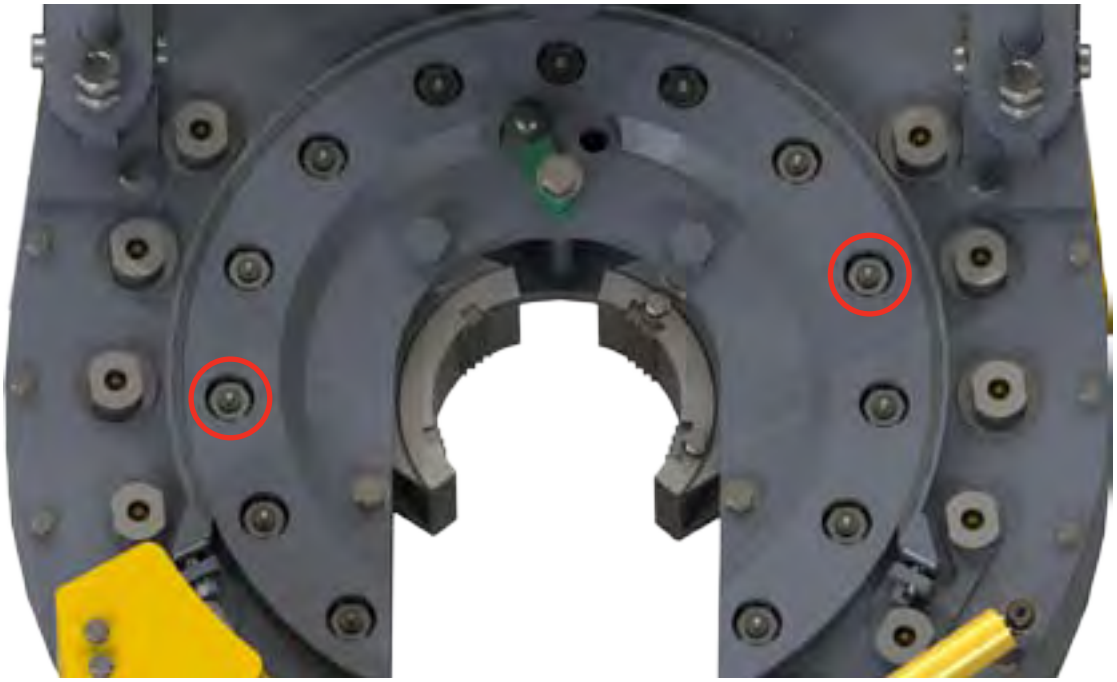


ILLUSTRATION 3.E.1: CAM FOLLOWER LUBRICATION

2. Support Rollers

Apply grease to the support roller bearings through the grease fittings recessed into the top and bottom of each support roller shaft (12 locations total).

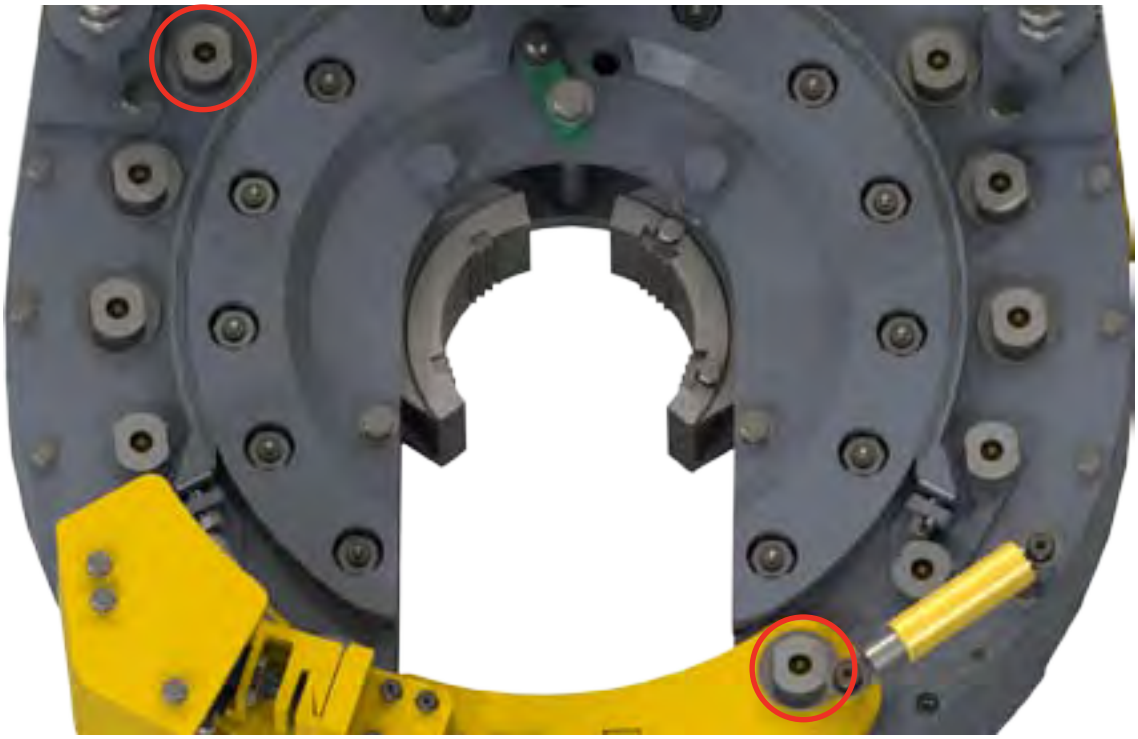


ILLUSTRATION 3.E.2: SUPPORT ROLLER LUBRICATION

3. Rotary Idlers

Apply grease to the rotary idler bearings through the grease fittings recessed into the top of each shaft on the top of the tong (two locations total).

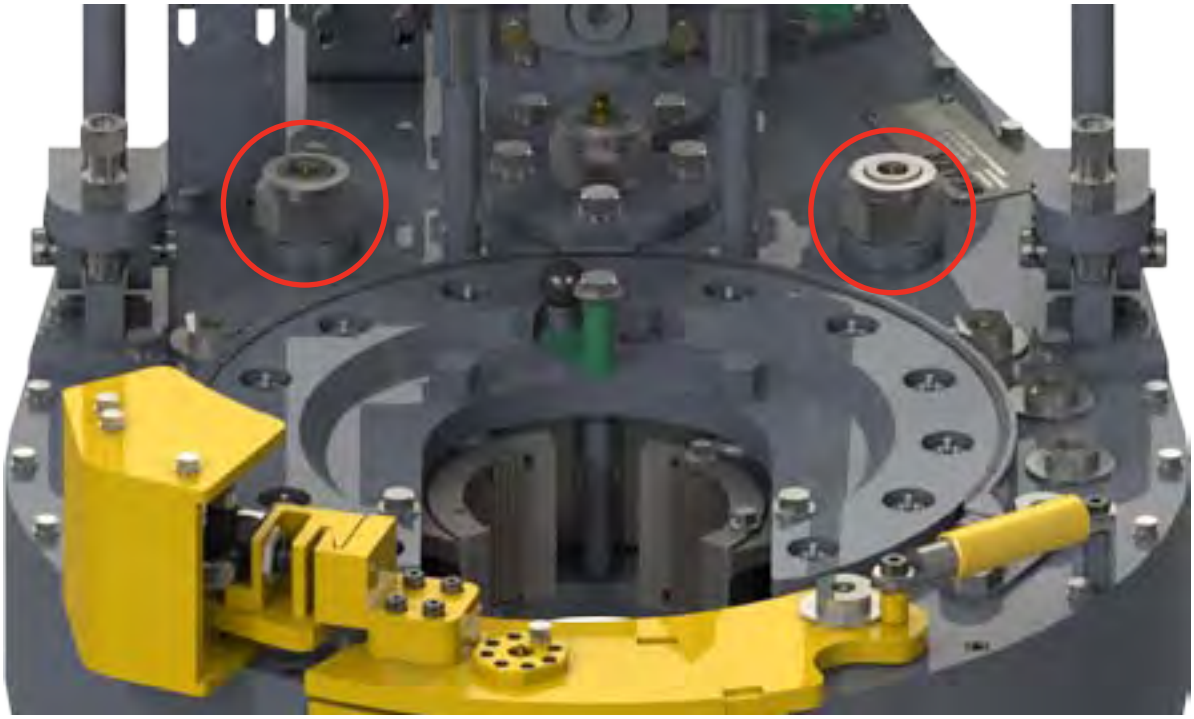


ILLUSTRATION 3.E.3: ROTARY IDLER LUBRICATION

4. Pinion Idler

Apply grease to the pinion idler bearing through the grease fitting located on the top face of the tong under the valve bank (one location only).

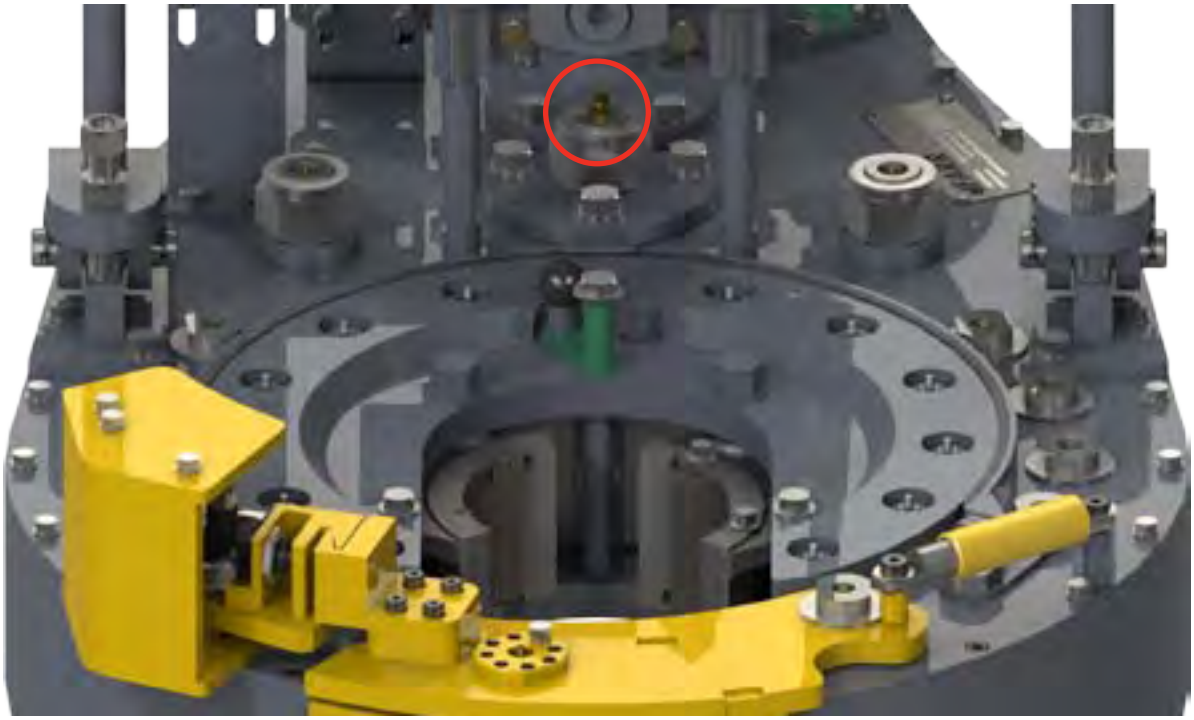


ILLUSTRATION 3.E.4: PINION IDLER LUBRICATION POINT

5. Pinion

Apply grease to the pinion bearings through the grease fittings located on the bearing caps on the top and bottom faces of the tong (two locations top, two locations bottom).

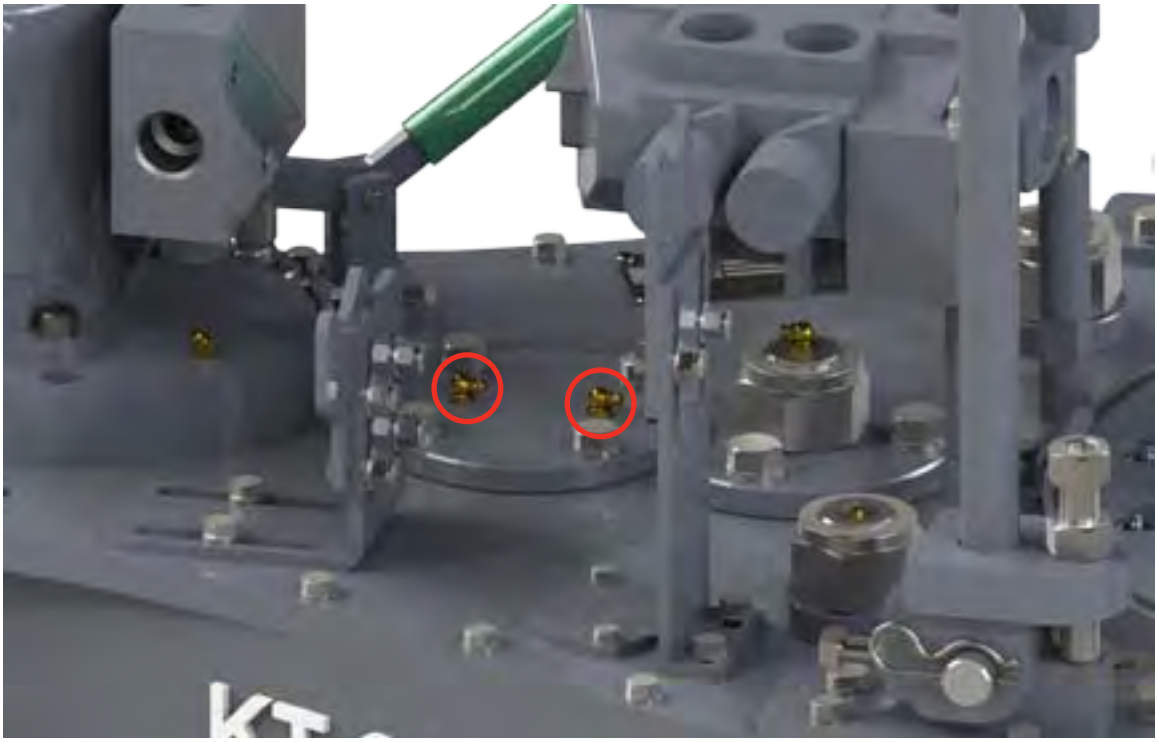


ILLUSTRATION 3.E.5: PINION LUBRICATION POINTS (TOP PLATE)

Pinion Lubrication (Continued):

ILLUSTRATION 3.E.6: PINION LUBRICATION POINTS (BOTTOM PLATE)

6. Clutch

Apply grease to the clutch bearings through the two grease fittings located on the clutch bearing cap on the bottom face of the tong, and the single grease fitting recessed into the end of the clutch shaft. (three locations total).

ILLUSTRATION 3.E.7: CLUTCH LUBRICATION POINTS

7. Motor Mount

Apply grease to the motor gear/clutch drive gear through the grease fitting located on the top of the motor mount (one location only).

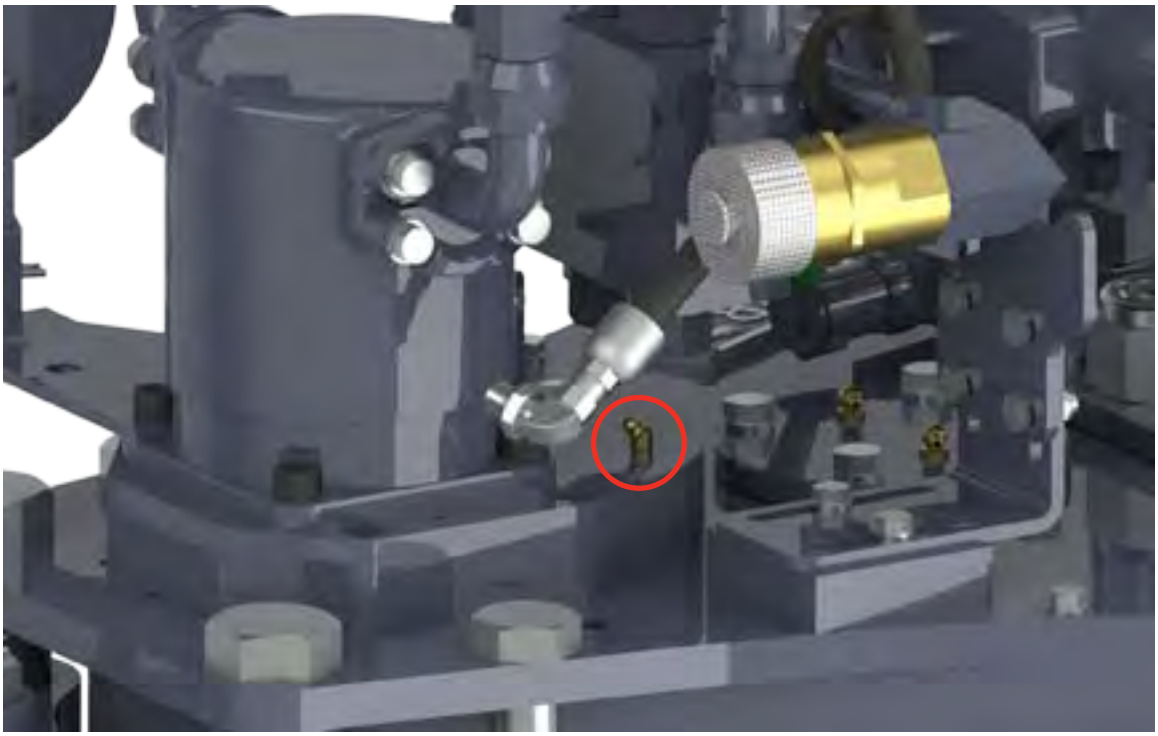


ILLUSTRATION 3.E.8: MOTOR MOUNT LUBRICATION POINT

8. Shifting Shaft

Apply grease to the shifting shaft and top shifting shaft bushing. The shaft and shifting yoke can be accessed through the cover plate on the side of the tong.

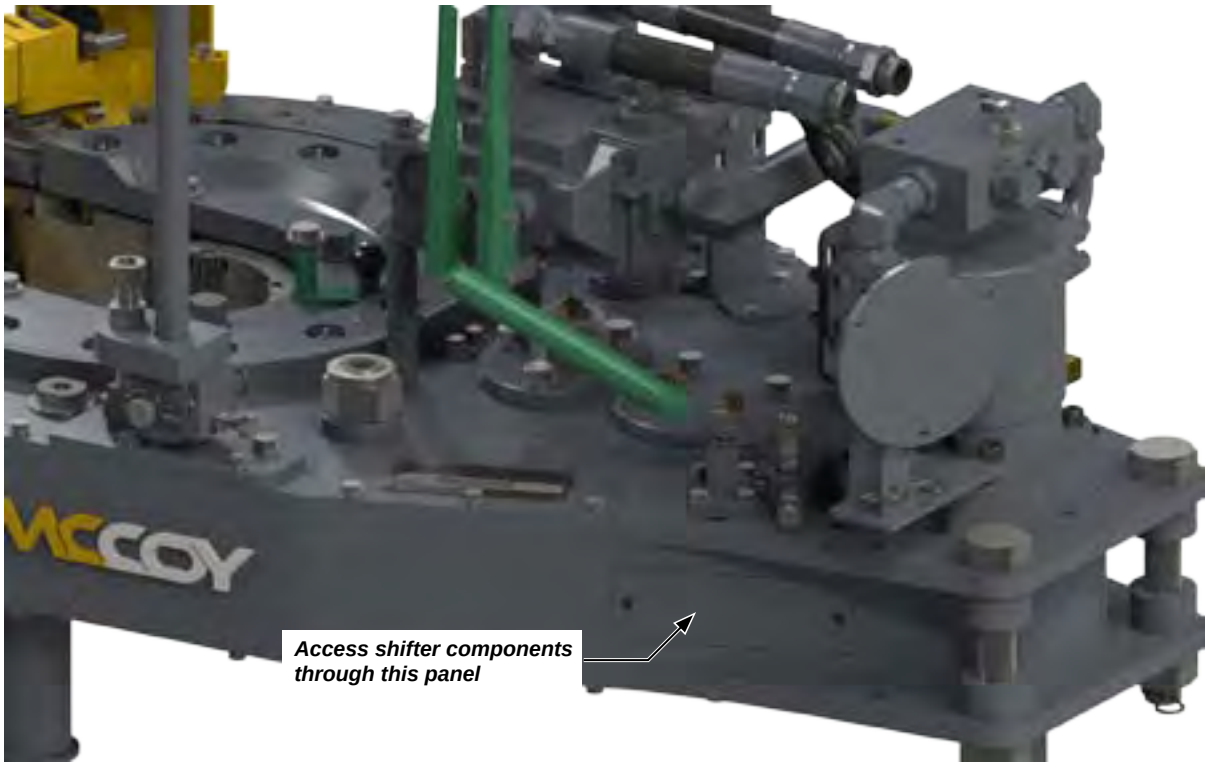


ILLUSTRATION 3.E.9: SHIFTER SHAFT LUBRICATION

9. Door Lubrication

Apply grease to the door latch adjustment cam through the grease fitting located in the top of the adjustment cam shaft. Apply grease to the contact surfaces of the safety door switch plunger.

ILLUSTRATION 3.E.10: TONG DOOR LUBRICATION POINTS

10. DOOR STOP CYLINDER

Periodically disassemble the door stop cylinders and coat the spring and cylinder with a general purpose lubricating oil.

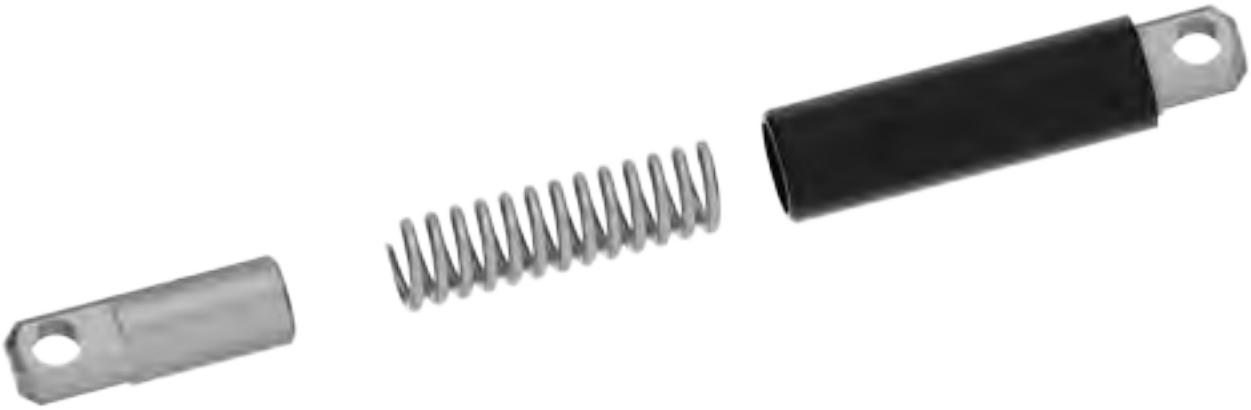


ILLUSTRATION 3.E.11: DOOR CYLINDER

THE DOOR STOP CYLINDER SPRING MAY RETAIN ENERGY FROM BEING COMPRESSED. USE A CLAMP TO CONTAIN THE ENDS OF THE CYLINDER WHEN IT IS REMOVED, AND RELIEVE THE SPRING TENSION GRADUALLY.

F. ADJUSTMENTS

1. Brake Band Adjustment:

The top and bottom brake bands must be periodically adjusted to continue to provide smooth and efficient jaw cam action. If the cage plate turns with the rotary gear, the jaws will not cam properly and, therefore, will not bite on the tubing or casing. Tightening the brake band against the cage plates will increase frictional resistance, allowing jaws to cam properly and grip the casing. Adjust the brake band using the adjustment nut and bolt set as shown in the illustration below. Use caution, as over-tightening will cause excessive wear to the brake bands.

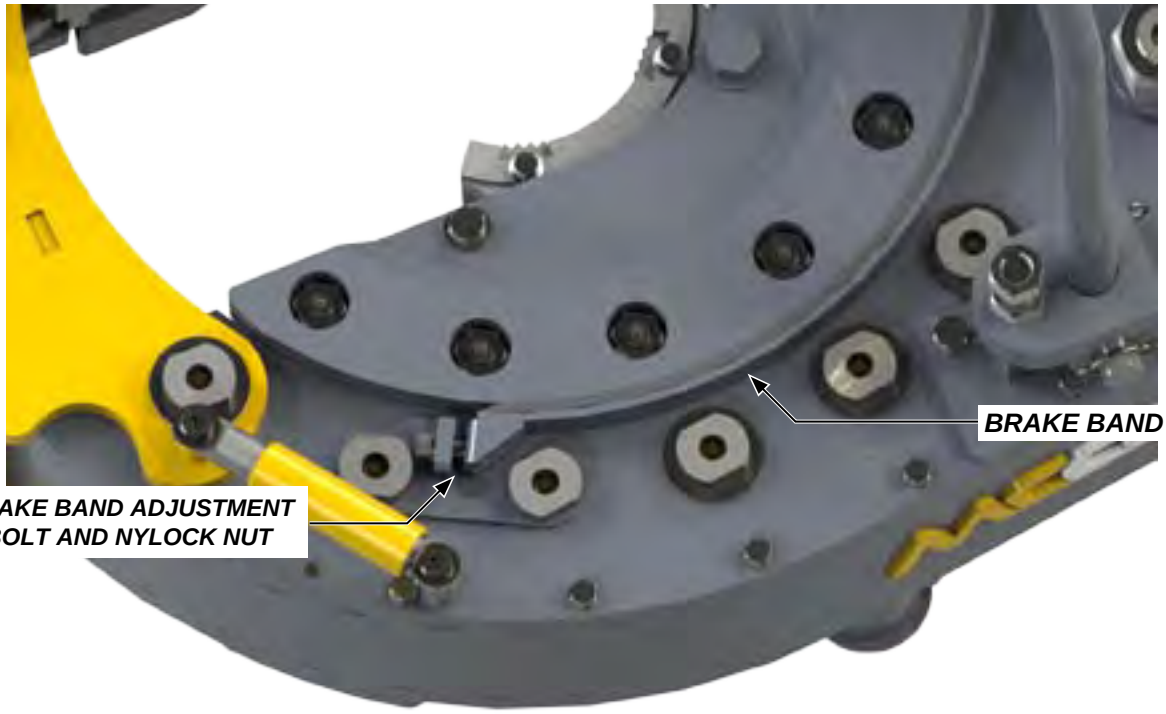


ILLUSTRATION 3.F.1: BRAKE BAND ADJUSTMENT

TOP AND BOTTOM BRAKE BANDS MUST BE ADJUSTED SIMULTANEOUSLY AND EQUALLY

2. Door Latch Adjustment

Normal operation of the tong may cause wear of the door latch, which will cause the door to develop a loose fit at the latch. A latch cam plate is located at the top face of the door. The cam plate has eight positioning holes located on a 360 degree bolt circle. The latch cam shaft extends down through the door and is secured at the top by a 3/8" hex head bolt. To make adjustments in door alignment, remove the 3/8" bolt and turn the cam with a wrench. When the door has been adequately aligned, replace the 3/8" bolt.

THE DOOR IS AN IMPORTANT PART OF THE STRUCTURAL INTEGRITY OF THE TONG. IT IS IMPERATIVE TO KEEP A SECURE FIT AT THE DOOR IN ORDER TO MAINTAIN PROPER GEAR ALIGNMENT, AND TO MINIMIZE THE POSSIBILITY OF DAMAGE TO THE GEAR TRAIN WHEN OPERATING THE TONG AT SPECIFIED TORQUE. A CLOSED DOOR ALSO ENSURES SAFETY OF OPERATING PERSONNEL.

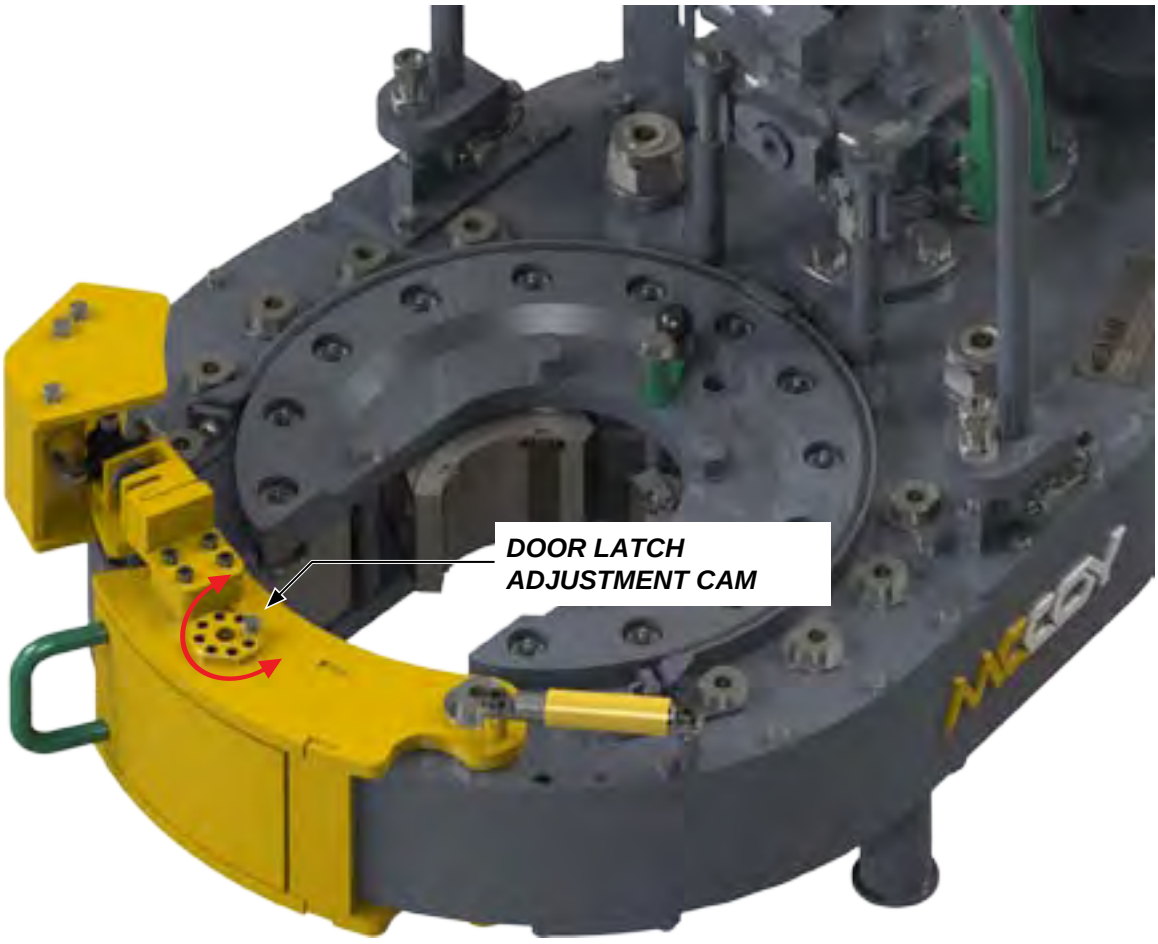


ILLUSTRATION 3.F.2: DOOR LATCH CAM ADJUSTMENT

3. Shifter Detent Force Adjustment:

Over time wear to the shifting shaft, wear to the detent ball, and loss of spring tension in the detent spring may result in a loose or "sloppy" fit within the top shifter bushing. The detent pressure may be increased or otherwise adjusted by loosening the 7/16" UNF locking jam nut, and turning the 7/16" UNF detent bolt. Should adequate detent action not be achieved, the shifting shaft, detent ball, or detent spring (or possibly all three) may need to be replaced (see Pp. 5.16 - 5.17).

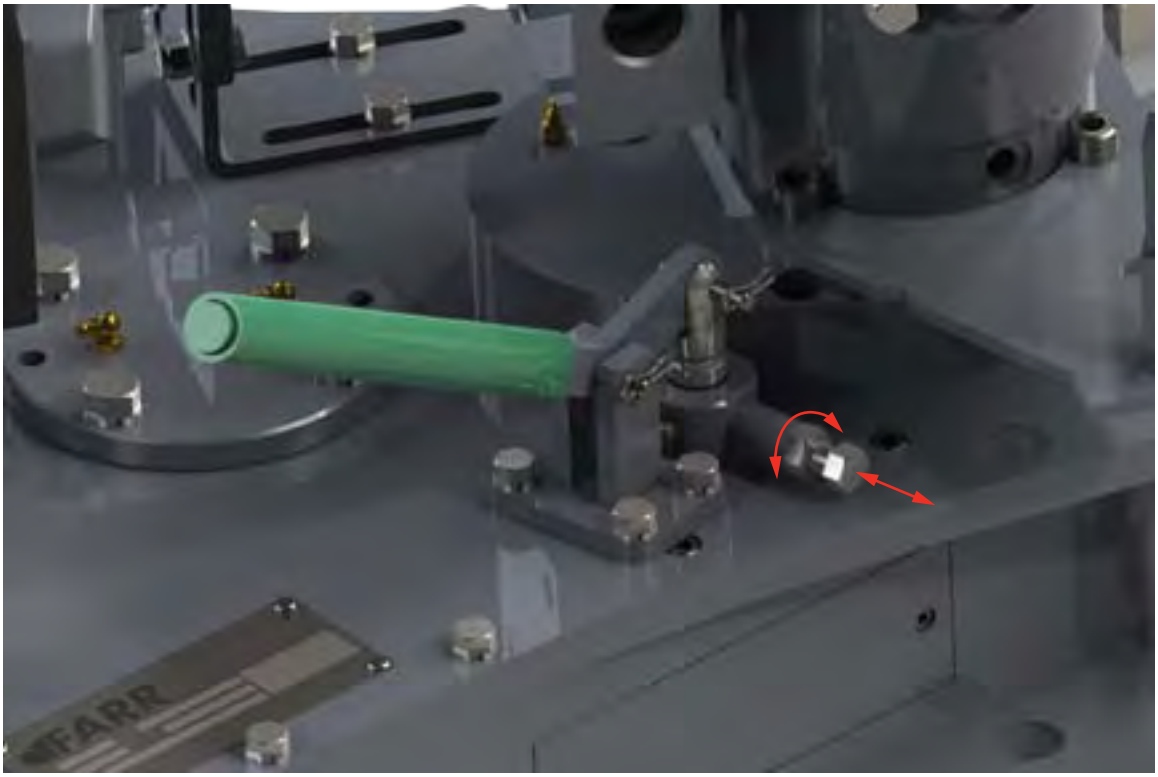


ILLUSTRATION 3.F.3: SHIFTER DETENT FORCE ADJUSTMENT

4. Safety Door Adjustment:

The safety door system is the prime protective measure separating the operator from the rotary gear, and must be in working condition when operating tong. The safety door switch is designed to interrupt hydraulic power to the motor when the tong door is opened, or even slightly ajar. This is a critical safety system, and proper adjustment is necessary to maintain the intended function.

KEEP HANDS CLEAR OF SAFETY DOOR LATCH CLAWS (PAINTED YELLOW) WHEN CLOSING DOOR.

If the rotary gear does not stop immediately and completely stop rotating when the door is opened, remove the tong from service and perform the following adjustments:

a. *Remove the top plate from the safety door guard. Wire ties (if applicable) require removal before the fasteners on the top plate of the door guide can be replaces.*

b. *Perform an initial alignment of the safety door mechanism. Close the tong door. Ensure the two safety door "claws" are seated firmly together. Slightly loosen the hex bolts securing the adjustment plate - tap the bottom adjustment plate one way or the other until the shoulder bolts on the floating plate are in the centre of the traveling slots (see Illustration 3.F.4).*

Safety Door Adjustment (continued):

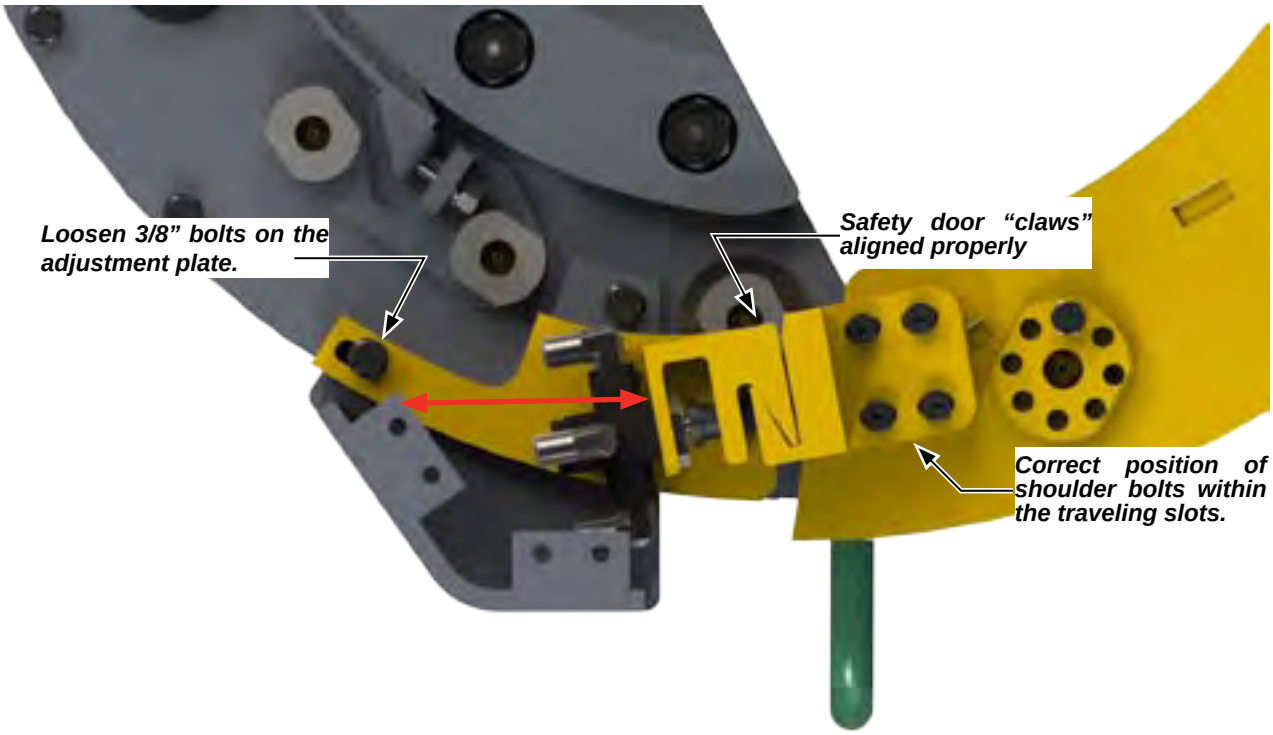

Loosen 3/8" bolts on the adjustment plate.
Safety door "claws" aligned properly
Correct position of shoulder bolts within the traveling slots.

ILLUSTRATION 3.F.4: SAFETY DOOR SWITCH ADJUSTMENT 01

c. *Once the adjustment plate has been satisfactorily adjusted, tighten the 3/8" bolts on the adjustment plate.*

d. *Test the safety door system. Connect hydraulic power to the tong. Ensure the door is closed and all personnel are clear. Begin rotating the cage plate. Open the tong door - the cage plate should immediately and completely stop.*

e. *If the cage plate does not stop rotating, further adjustment of the safety door switch is required. Stop rotation and remove hydraulic power from the tong.*

f. *Slightly loosen the hex bolts securing the adjustment plate - tap the bottom adjustment plate toward the centre of the tong in small increments (i.e. about 1 mm at a time). After each adjustment the safety door mechanism must be re-tested to determine if safety door function has been restored. Repeat steps d, e, & f until satisfactory safety door function has been established.*

g. *If adjustment limits have been reached before safety door function has been established further troubleshooting of the safety door system is required before the tong is placed into service.*

G. RECOMMENDED PERIODIC CHECKS

1. Door Stop Spring

The spring inside the actuator cylinder must be of sufficient strength to enable the door latch mechanism to snap closed properly. Door stop spring fatigue will result in sluggish latch operation. Replace the latch spring inside the cylinder when this occurs.

2. Shifting Shaft

The shifting yoke is secured to the shifting shaft by one hex jam nut and one locknut on the bottom of the yoke. Check these nuts after each job. Do this by removing the clutch inspection plate and ensuring a snug fit prior to lubrication.

3. Backing Pin

Perform a visual inspection of the backing pin after each job. Replace the pin if stress cracks or excessive wear is found, or if the pin appears bent.

4. Torque Gauge Assembly

Periodic calibration of the torque gauge is recommended to assure accurate torque readings. When having the torque gauge serviced and calibrated, it is critical to note the arm length of the tong, as indicated on page 1.3.

H. OVERHAUL PROCEDURES - DISASSEMBLY

Once the tong has been removed from the backup it may be overhauled using the disassembly instructions specified in the following procedure. Access to the gear train is possible by removal of the top plate of the tong.

ALL MAINTENANCE AND OVERHAUL SHOULD BE PERFORMED FROM THE TOP. THE BOTTOM PLATE OF THE TONG IS TYPICALLY WELDED TO THE SIDE BODY AND CANNOT BE REMOVED.

REPLACEMENT FASTENERS (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT.

FASTENERS USED FOR MAINTENANCE OR OVERHAUL OF LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, LEGS) MUST BE TIGHTENED TO THE PROPER TORQUE

1. *Use a crane to lift the tong on to a sturdy support structure that is capable of safely supporting the entire weight of the tong while still allowing access to the bottom cage plate. Metal horses work well for this application.*
2. *If not already done, remove the two jaws.*
3. *Support the rigid sling with a crane. Remove the two hitch pins from each rigid sling pin, and remove the rid sling pins. The rigid sling may now be lifted away from the tong and stored in a secure location. Remove both rigid sling hanger bracket weldments.*

The heads of the fasteners securing the rigid sling hanger brackets are drilled, and are constrained to the brackets using wire ties. Wire ties must be removed before extracting the fasteners and removing the rigid sling hanger bracket.

4. *Disconnect all flexible hydraulic lines running from the safety door switch and motor at the motor side i.e. leave the lines connected to the safety door switch. Disconnect both 1" hydraulic lines at the motor.*
5. *Support the hydraulic valve assembly with a temporary lifting sling and a crane. Remove the 1/2" x 4-1/2" bolts securing the hydraulic valve assembly to the valve support posts. Lift the hydraulic valve section up and away from the top plate of the tong. If the hydraulic valve assembly does not require service ensure it is stored in a clean, secure location. Cover all exposed connections.* ***DISASSEMBLY NOTE (CE MARKED TONGS ONLY):*** *The valve handle guard does not need to be removed from the valve bank. Do not lift the valve assembly using the protective handle.*
6. *Remove the inlet and outlet support pieces.*
7. *Remove the top and bottom brake band weldments, leaving the adjustment lug weldments in place for now.*
8. *Remove the tong door stop cylinder. The door stop cylinder spring may retain energy from being compressed. Use a clamp to contain the ends of the cylinder when it is removed, and relieve the spring tension gradually.*

THE DOOR STOP CYLINDER SPRING MAY RETAIN ENERGY FROM BEING COMPRESSED. USE A CLAMP TO CONTAIN THE ENDS OF THE CYLINDER WHEN IT IS REMOVED, AND RELIEVE THE SPRING TENSION GRADUALLY.

9. *Remove the tong door assembly:*
   - *i. Remove the nylock nut and flat washer securing the door pivot roller shaft.*
   - *ii Use a soft alloy material (e.g. brass rod) to lightly tap the shaft up through the support roller assembly until it comes free at the top. Use caution that the threads on the ends of the support roller shafts are not damaged.*
   - *iii. The door assembly is relatively light weight and may be moved using man power. However, a temporary lifting sling and crane may also be used.* ***DISASSEMBLY NOTE:*** *the shoulder bushings for the door may become dislodged. If the bushing are to be re-used rather than replaced use caution not to lose them.*
10. *Disconnect the three hydraulic connections from the motor. Undo the restraints securing the inlet and outlet lines connections to their supports, and lift the hydraulic valve section away from the tong. Remove the inlet and outlet support pieces.*
11. *Remove top brake band assembly (leave adjustment lug weldments in place for now).*
12. *Remove the tong door stop cylinder. The door stop cylinder spring may retain energy from being compressed. Use a clamp to contain the ends of the cylinder when it is removed, and relieve the spring tension gradually.*
13. *Remove door assembly by removing the door roller shaft. Support door assembly as the roller shaft is removed. Remove the nut from the top of the roller shaft, and use a soft alloy material (e.g. brass rod, etc.) to lightly tap the shaft down through the support roller assembly until it comes free at the bottom. Use caution that the threads on the ends of the support roller shafts are not damaged. Do not lose the door shoulder bushings.*

REMOVAL OF TOP PLATE (Continued):

14. *Remove the hitch pin securing the torque gauge holder to the torque gauge mount weldment, and remove the mount.*
15. *Remove the four hex socket head cap screws securing the motor and the torque gauge mount weldment. Remove the torque gauge mount weldment, then lift the motor up and away from the motor mount. Inspect the motor gear, located at the bottom of the motor shaft, for gear clashing or tooth damage. Also, ensure that the motor gear is securely attached to the motor shaft.*
16. *Remove the cotter pin and clevis pin connecting the shifter handle to the shifter shaft (it is not necessary to disconnect the handle from the pivot lug weldment).*
17. *Unbolt the pivot lug weldment from the top plate, and remove the pivot lug and handle assembly.*
18. *Remove the four hex socket head cap screws securing the motor mount to the top plate. Use care not to dislodge and lose the two positioning dowels.*
19. *Remove the snap ring securing the drive gear to the top of the clutch shaft. Carefully remove the drive gear from the clutch shaft.*
20. *Remove the two 10-24 x 3/4" hex socket head cap screws securing the top clutch bearing retainer to the top plate.*
21. *Remove the top clutch bearing retainer, and bearing retainer spacer. The top clutch bearing and clutch bearing bushing may come off with the bearing retainer.*
22. *Remove the 1-1/4" nylock nut and the three 5/8" bolts securing the pinion idler half-moon pad.*
23. *Pull the top pinion gear bearing cap by removing the four 1/2" bolts which secure the bearing cap. Thread two of the removed bolts into the extra holes on top of the bearing cap, and use them as lifting lugs to lift the bearing cap out of place.*

IF THE BEARING REMAINS ATTACHED TO THE GEAR SHAFT AFTER THE BEARING CAP IS PULLED, MCCOY SERVICE PERSONNEL RECOMMENDS LEAVING IT IN PLACE UNTIL THE TOP TONG PLATE IS REMOVED.

24. *Ensure the bottom cage plate is supported before beginning this step (weight - 80 lbs / 36.4 kg). Remove the two front cage plate bolt and nut sets. Remove the backing pin assembly and the rear cage plate bolt, and the cage plate spacers. The top and bottom cage plates may now be removed - Note that the cam followers are fastened to the top and bottom cage plates, so use caution not to damage them.*

THE CAGE PLATE BOLTS ARE THE ONLY ITEMS FASTENING THE BOTTOM CAGE PLATE TO THE TONG. SUPPORT THE BOTTOM CAGE PLATE FROM BELOW PRIOR TO REMOVING CAGE PLATE BOLTS IN ORDER TO PREVENT DAMAGE TO THE BOTTOM CAGE PLATE OR PERSONAL INJURY TO THE MECHANIC

25. *Remove the top nuts and pads for the rotary idler gears.*
26. *Remove the remaining support roller shafts. Note that the top brake band adjustment lug weldments are removed at this point.*
27. *Loosen, but do not remove the detent bolt on the top shifter lug weldment. Once the force from the detent ball has been removed from the shifter shaft, the top shifter bushing can be un-threaded from the top plate. Take care not to lose the detent ball when the bushing comes free of the shaft.*
28. *Remove the hex head bolts and hex flat head cap screws around the perimeter of the tong that secure the top plate.*
29. *With all the above steps taken, the top tong plate can be lifted off providing access to the inside of the gear case.*

I. ASSEMBLY PROCEDURES

Assembly of Farr Hydraulic Power Tongs is simple, and can be accomplished without the use of special tools. The instructions on this page are presented as a guide only, and are similar to the assembly sequence our technician would use while assembling the tong in our plant.

NOTE ON INSTALLATION PRACTICES: Ensure all bearings are liberally greased before installing over a shaft or into gears or bearing caps. When inserting a shaft through a support roller assembly ensure shaft is greased. Also ensure all metal-to-metal contact in the gear train is adequately greased. When graphics are not used in the assembly process, please refer to the relevant exploded diagrams in Section 5.

ALL FASTENERS USED DURING REASSEMBLY OF LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS) MUST BE TIGHTENED TO THE CORRECT TORQUE. THREADED FASTENERS USED IN LOAD-BEARING DEVICES MUST BE SECURED WITH RED LOC-TITE™.

TIGHTENING TORQUE GUIDE			
SAE GRADE 8 - FINE THREAD			
SIZE	CLAMP LOAD	PLAIN	PLATED
1/4 - 28 (.250)	3,263	14 ft. lbs.	10 ft. lbs.
5/16- 24 (.3125)	5,113	27 ft. lbs.	20 ft. lbs.
3/8 - 24 (.375)	7,875	49 ft. lbs.	37 ft. lbs.
7/16 - 20 (.4375)	10,650	78 ft. lbs.	58 ft. lbs.
1/2 - 20 (.500)	14,400	120 ft. lbs.	90 ft. lbs.
9/16 - 18 (.5625)	18,300	172 ft. lbs.	129 ft. lbs.
5/8" - 18 (.625)	23,025	240 ft. lbs.	180 ft. lbs.
3/4 - 16 (.750)	33,600	420 ft. lbs.	315 ft. lbs.
7/8" - 14 (.875)	45,825	668 ft. lbs.	501 ft. lbs.
1 - 12 (1.000)	59,700	995 ft. lbs.	746 ft. lbs.
1 - 14 (1.000)	61,125	1019 ft. lbs.	764 ft. lbs.
1 1/8 - 12 (1.125)	77,025	1444 ft. lbs.	1083 ft. lbs.
1 1/4 - 12 (1.125)	96,600	2012 ft. lbs.	1509 ft. lbs.
1 3/8 - 12 (1.375)	118,350	2712 ft. lbs.	2034 ft. lbs.
1 1/2 - 12 (1.500)	142,275	3557 ft. lbs.	2668 ft. lbs.
SAE GRADE 8 - COARSE THREAD			
SIZE	CLAMP LOAD	PLAIN	PLATED
1/4 - 20 (.250)	2,850	12 ft. lbs.	9 ft. lbs.
5/16- 18 (.3125)	4,725	25 ft. lbs.	18 ft. lbs.
3/8 - 16 (.375)	6,975	44 ft. lbs.	33 ft. lbs.
7/16 - 14 (.4375)	9,600	70 ft. lbs.	52 ft. lbs.
1/2 - 13 (.500)	12,750	106 ft. lbs.	80 ft. lbs.
9/16 - 12 (.5625)	16,350	153 ft. lbs.	115 ft. lbs.
5/8" - 11 (.625)	20,325	212 ft. lbs.	159 ft. lbs.
3/4 - 10 (.750)	30,075	376 ft. lbs.	282 ft. lbs.
7/8" - 9 (.875)	41,550	606 ft. lbs.	454 ft. lbs.
1 - 8 (1.000)	54,525	909 ft. lbs.	682 ft. lbs.
1 1/8 - 7 (1.125)	68,700	1288 ft. lbs.	966 ft. lbs.
1 1/4 - 7 (1.125)	87,225	1817 ft. lbs.	1363 ft. lbs.
1 3/8 - 6 (1.375)	103,950	2382 ft. lbs.	1787 ft. lbs.
1 1/2 - 6 (1.500)	126,450	3161 ft. lbs.	2371 ft. lbs.

REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.

Assembly Procedure:

1. *Position the tong body gear case on a suitable stationary support, ensuring that the bottom body plate remains accessible. A set of sturdy metal horses works well in this application.*
2. *Slide a support roller shaft spacer (PN 1037-C-134) into the centre of each support roller (PN 1037-135) (total of 12).*
3. *Press support roller bearings (PN 02-0094) into each side of the support rollers. Assemble five support roller assemblies as shown on Pp. 5.4 - 5.5.*
4. *Install five support roller assemblies along one side of the body case. Insert shafts through assemblies, but do not install the bottom nylock nuts or, where used, the top washers.*
5. *Thread two rated 1/2" UNC eye bolts in to the rotary gear (weight = 200 lbs / 91 kg) to serve as temporary lifting points. Install rotary gear, making sure the backing pin slots are on the side facing up. Keep fingers clear of pinch points as rotary gear is positioned in the tong opening. Ensure one side is supported by the support rollers installed in Step 4, and have the opening in the rotary gear oriented as shown in illustration 3.I.1.*

ILLUSTRATION 3.I.1: TONG ASSEMBLY - ROTARY GEAR INSTALLATION

6. *Install support roller assemblies in the locations exposed by the opening in the rotary gear. Continue to rotate the rotary gear, installing support roller assemblies in the rotary gear opening as it is rotated. Finish with the rotary gear aligned with the opening in the bottom plate and completely supported by the support rollers. Do not install the door pivot support roller assembly at this time.*
7. *Press pinion bearing (PN 02-0007) into bottom pinion bearing cap (PN 1050-89), and install bearing cap into bottom plate of tong using four 1/2" UNC x 1-1/2" hex bolts and 1/2" lock washers.*
8. *Press lower clutch bearing (PN 02-0004) into clutch bearing cap (PN 1050-C1-54), and install bearing cap into bottom plate of tong using four 3/8" UNC x 1-1/2" hex bolts and 3/8" lock washers.*
9. *Install a retainer clip (PN 02-0009) into both rotary idler gears (PN 997-A2-119). Press an idler bearing (PN 02-0011) into each gear and secure with a second retainer clip.*
10. *Lightly grease the larger circumference of the two rotary idler shafts (PN 1050-D5-117) and slide them through the bearing and gears assemblies, centering the gear on the shaft.*
11. *Slide two bearing seals (PN 02-0010) over each end of the idler shafts and press against the retainer clips (see Pp. 5.6 - 5.7 for correct orientation).*
12. *Slide a bearing spacer (PN 1050-D5-121) over each end of the rotary idler shafts.*
13. *Place each rotary idler assembly through the bottom plate, ensuring the ends of the shafts with the threaded hole for the grease fitting are pointed upward and the rotary idler gears mesh with the rotary gear.*

Assembly Procedure (continued...):

14. *Place an idler pad (PN 997-D20-125) over the bottom side of each rotary idler shaft, and secure each with a 1-1/2" UNF nylock nut.*
15. *The low pinion gear (PN 997-A5-88) is machined with shoulders around the centre spline on both sides of the gear. Place the side of the low pinion gear with the smaller shoulder over the lower bearing and bearing cap, centering as best as able.*
16. *Install pinion gear shaft (PN 997-A7-86) into the spline of the bottom pinion gear and the lower pinion bearing.*
17. *Slide 2 needle bearings (PN 02-0003) over each end of the clutch shaft (PN 997-A8-50), and press up against centre gear. Slide low clutch gear (PN 997-A1-52) over the bottom end of the clutch shaft (the bottom end of the clutch shaft can be identified by the threads for the grease fitting machined into the end) onto the two needle bearings. Ensure the smaller diameter of the low clutch gear is directly adjacent to the centre gear on the clutch shaft. Place lower end of clutch shaft into the lower clutch bearing that has been pre-mounted in the lower body plate.*
18. *Install shifting collar (PN 997-A9-62) over the top of the clutch shaft and mesh with low clutch gear and the centre gear on the clutch shaft.*
19. *Place the shifting fork weldment (PN 1050-72) against the shifting collar, roughly in its final position.*
20. *Install a retainer clip (PN 02-0009) into the pinion idler gear (PN 997-A2-119). Press an idler bearing (PN 02-0011) into the gear, and secure with the second retainer clip.*
21. *Slide the pinion idler half-shaft (PN 1050-D5-105) through the pinion idler gear assembly. Slide the bearing seal (PN 02-0010) over the end of the half-shaft, and secure to the half-shaft with a shaft retainer clip (PN 02-0008).*
22. *Place pinion idler assembly, less the idler pad and top fastener, on top of the lower pinion gear and position it as best as possible - their position may have to be adjusted slightly as the top plate is attached (see illustration 3.H.2).*

ILLUSTRATION 3.I.2: TONG ASSEMBLY - GEAR ASSEMBLY POSITIONING

23. *The high pinion gear (PN 997-A4-87) is machined with shoulders around the centre spline on both sides of the gear. Place the side of the high pinion gear with the larger shoulder over the top of the splined pinion shaft and press against the centre gear on the pinion shaft.*
24. *Install high clutch gear (PN 997-A1-51) on to the clutch shaft, ensuring the smaller diameter is directly adjacent to the centre gear on the clutch shaft.*
25. *Carefully remove all support roller shafts, using caution not to shift the position of the installed support roller assemblies or to damage the threads on the end of the shafts.*
26. *Locate the three un-threaded holes in the side body of the tong, one in the rear centre and one just to either side of the front opening. If old dowel pins are in place, remove them before installation of the top plate. If the dowel pins are in any way damaged or deformed McCoy recommends replacing them with new 3/8" x 1-1/2" hardened dowel pins. If necessary clean the dowel pin holes, and do not insert dowel pins until after the top plate has been installed.*

Assembly Procedure (continued...):

27. *Use a temporary lifting sling and crane to maneuver the top plate (PN 1050-7T) into position, and place on to the side body. Insert the three positioning dowel pins (PN 09-0092) through the top plate into their respective holes in the side body. Use a hammer to tap the dowel pins until they are flush with the top plate. Secure the top plate with 14 3/8" UNC x 1-1/2" hex bolts and 3/8" lock washers, and ten 3/8" UNC x 1" hex socket head cap screws as shown in illustration 3.H.3. Do not install fasteners at the rigid sling hanger locations, indicated by the red circles, or the door cylinder mounting lug location indicated by the green circle.*

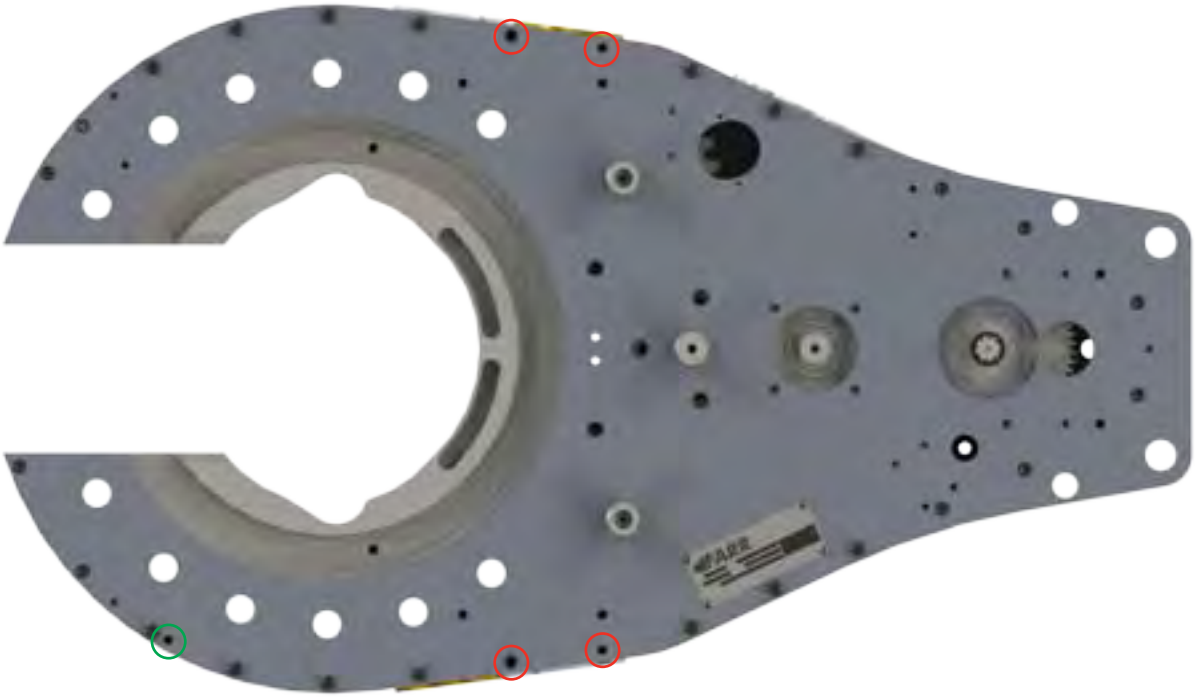


ILLUSTRATION 3.I.3: TONG ASSEMBLY - TOP FASTENER LOCATIONS

28. *Install half-moon idler pad (PN 997-D17-109) over the end of the pinion idler shaft and secure with three 5/8" UNC x 2-3/4" hex bolts and 5/8" lock washers, followed by a 1-1/2" UNF nylock nut.*
29. *Slide the remaining rotary idler pads over the rotary idler shafts and secure with 1-1/2" UNF nylock nuts.*
30. *Press the remaining pinion bearing (PN 02-0007) into the remaining pinion bearing cap and install over the top of the pinion gear shaft - secure with four 1/2" UNC x 1-1/2" hex bolts and 1/2" lock washers.*
31. *Install top clutch bearing retainer (PN 997-D11-59) over the clutch shaft into the cutout in the top plate and secure with two 10-24 x 3/4" hex socket head cap screws.*
32. *Insert top clutch bearing (PN 02-0002), followed by the clutch bearing bushing (PN 997-60).*
33. *Install clutch drive gear (PN 997-A3-61) and secure with retaining snap ring (PN 1234-00-04).*

Assembly Procedure (continued...):

34. *Re-install support roller shafts:*

    i) *Install all support roller shafts (PN 101-3939) that are NOT coincidental with the brake band lug weldments as shown in illustration 3.H.5 (seven total). Ensure a 1-1/8" narrow flat washer is installed on the support roller shaft before inserting through the top body plate and support roller assemblies. Do not install the door pivot roller at this time.* ***ASSEMBLY NOTE:*** *The shafts coincidental with the front leg weldments are shown circled in red.*

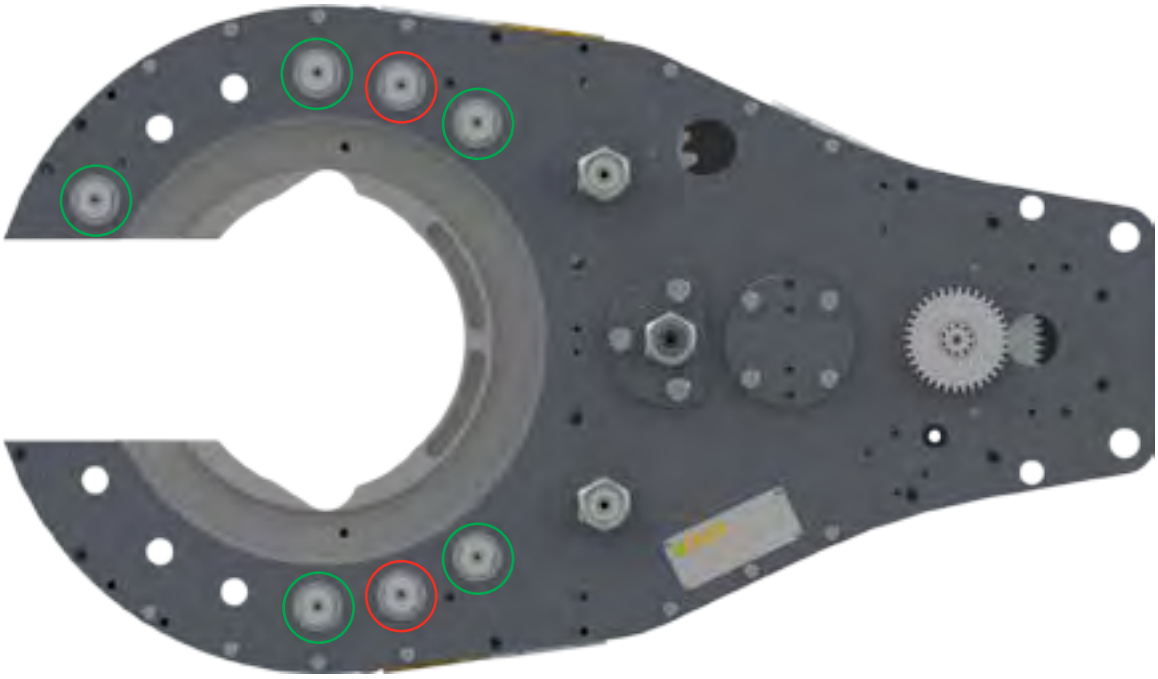


ILLUSTRATION 3.I.4: TONG ASSEMBLY - SUPPORT ROLLERS (SECURING LEG MOUNTS)

    ii) *Secure the bottoms of the support roller shafts with 1" narrow flat washers and 1" UNS thin nylock nuts. Install the RH front leg mount weldment (PN 101-0163) and the LH front leg mount weldment (PN 101-0162) on the to the support roller shafts using 1" UNS thin nylock nuts and two 3/8" UNC x 1-3/4" hex bolts and lock washers per weldment (see Illustration 3.H.6).* ***ASSEMBLY NOTE:*** *Do not use flat washers when installing the 1" UNS nut on the shaft coincidental with the leg weldments.*

ILLUSTRATION 3.I.5: TONG ASSEMBLY - FRONT LEG INSTALLATION

Assembly Procedure (continued...):

34. *Re-install support roller shafts continued:*

    iii) *Install support roller shafts (PN 101-3939) in four locations where they are coincidental with the top and bottom brake band lug weldments (top left & bottom right weldment PN = 101-0083, top right & bottom left weldment PN = 101-0096) as shown in illustration 3.H.7. These support rollers do not use top or bottom washers.*

ILLUSTRATION 3.I.6: TONG ASSEMBLY - SUPPORT ROLLERS (BRAKE BAND WELDMENTS)

35. *Coat the threads of the top shifter bushing (PN 101-0020) with red Loctite™. Thread the top shifter bushing into the top plate until snug. Thread the detent tube (PN 101-0019) into the top shifter bushing as shown in illustration 3.I.7.*

36. *Insert the shifting shaft (PN 1116-71) through the top shifter bushing in to the shifting fork installed in Step 19. Secure the shaft to the shifting fork with a 5/8" UNF hex nut and 5/8" UNF hex jam nut. Place the end of the shifting shaft in the lower shifting bushing (welded to the bottom plate) and ensure the shifting fork is meshed with the shifting collar.*

37. *Thread three 5/8" UNC x 5/8" hex socket set screws into the remaining three ports in the bushing - these set screws are intended to be used as contamination barriers only. Do not bottom out the set screws on the shifting shaft, or the shaft will not move.*

Assembly Procedure (continued...):

38. *Insert the shifter detent ball (PN 02-0018) into the detent tube, followed by the detent spring (PN 01-0040). Thread a 7/16" UNF hex jam nut onto a 7/16" UNF x 1-1/4" hex nut, then thread the 7/16" bolt into the detent tube. This is the detent force adjustment bolt and lock nut.*

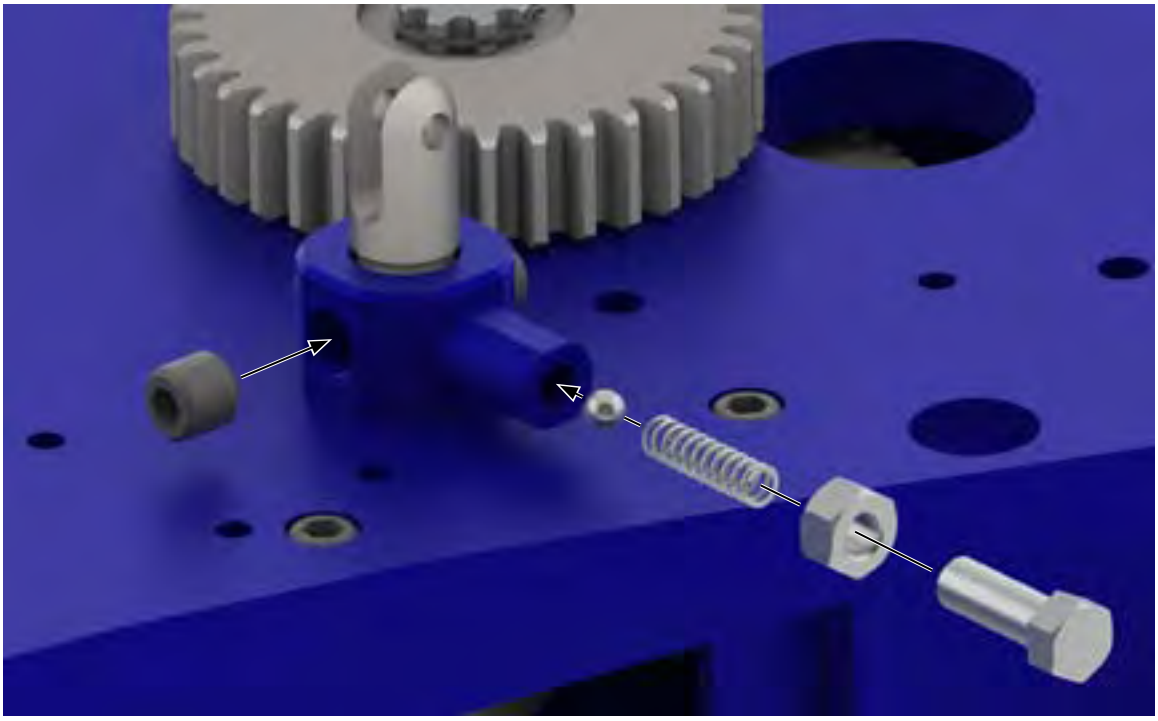


ILLUSTRATION 3.I.7: TONG ASSEMBLY - TOP SHIFTER BUSHING ASSEMBLY

39. *Insert two 5/16" x 1-1/4" dowel pins (PN 09-0033) into the un-threaded holes in the rear of the tong, behind the clutch drive gear on either side of the cutout in the top plate. Pre-clean the dowel pin holes if necessary.*
40. *Place motor mount (PN 1050-150) on to top plate over the dowel pins installed in the previous step, and secure with four 1/2" UNC x 1-1/2" hex socket head cap screws.*
41. *Bolt the shifter lug weldment (PN 101-0016) onto the top plate with four 3/8" UNC x 1-1/4" hex bolts and 3/8" lock washers.*
42. *Press the 5/16" square x 1-1/2" gear key in to the key slot in the hydraulic motor (PN 87-0112) shaft. Slide the motor gear (PN 997-A10-149) on to the motor shaft, securing with two 3/8" UNC x 3/8" flat point hex socket set screws.*
43. *Install the motor on to the motor mount. Secure the RH side of the motor to the motor mount with two 1/2" UNC x 1" hex socket head cap screws and 1/2" lock washers.*
44. *The LH side of the motor is secured with two 1/2" UNC x 1-1/4" hex socket head cap screws and 1/2" lock washers, which also secures the torque gauge holder weldment (PN 1500-09-04A).*
45. *Install shifting handle weldment (PN 1037-D-20B). Secure the handle to the shifter shaft and shifter pivot lug weldment with 5/16" x 1-1/2 clevis pins. Use a hitch pin on each clevis pin to ensure they do not become dislodged.*
46. *Install thirteen cam followers (PN 02-0015) in the top cage plate (PN 1050-21), and secure each a with 5/8" UNF hex jam nut and 5/8" lock washer. Once installed the cam followers will ride in the top groove in the rotary gear.*
47. *Install thirteen cam followers (PN 02-0015) in the bottom cage plate (PN 1050-22), and secure each a with 5/8" UNF hex jam nut and 5/8" lock washer. Once installed the cam followers will ride in the bottom groove in the rotary gear.*
48. *Support the bottom cage plate assembly (weight - 80 lbs / 36.4 kg) against the bottom of the rotary gear, with the cam followers in the groove in the bottom of the rotary gear and the opening of the cage plate aligned with the opening in the tong body.*
49. *Place the top cage plate assembly (weight - 80 lbs / 36.4 kg) on the top of the rotary gear, with the cam followers in the groove in the top of the rotary gear and the opening of the cage plate aligned with the opening in the tong body.*

Assembly Procedure (continued...):

50. *Insert two cage plate spacers (PN 1050-C3-38) between the cage plates at the front of the cage plates next to the rotary gear. Secure the cage plates through the spacers using 1/2" UNC x 7-1/2" hex bolts, 1/2" narrow flat washers (on the bottom) and 1/2" UNC nylock nuts.*

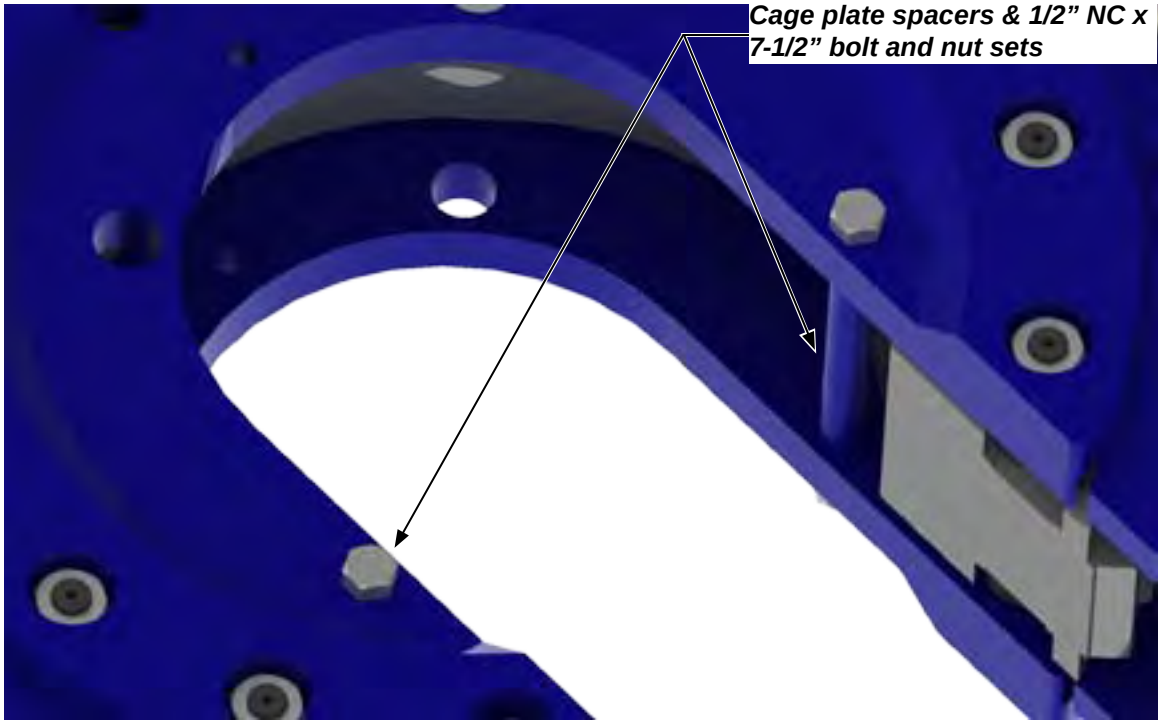


ILLUSTRATION 3.I.8: TONG ASSEMBLY - FRONT CAGE PLATE SPACERS

51. *Coat half of the threaded connecting stud (PN 101-4097) with blue Loctite and screw in to the backing pin (PN 101-4188).*
52. *Insert the exposed half of the threaded dowel pin through the smaller diameter hole of the backing pin retainer link (PN 101-4187). Slide the small backing pin spacer (PN 101-4096) over the threaded dowel against the backing pin retainer link. Thread the backing pin knob (PN 02-0017) on to the remaining threads of the exposed stud until tight.*
53. *Slide a 1/2" flat washer on to a 1/2" UNC x 9-1/2" hex bolt, followed by the backing pin spacer (PN 101-4186). Slide the larger diameter hole in the backing pin retainer link (PN 101-4187) over the end of the 9-1/2" hex bolt on to the backing pin spacer.*
54. *Position the remaining cage plate spacer (PN 1050-C3-38) between the cage plates at the rear of the opening. Insert the long bolt of the backing pin assembly through the cage plates and cage plate spacer, and the backing pin in to one of the backing pin holes at the rear of the top cage plate. Thread the bolt in to the bottom cage plate.*
55. *Thread the rear door cylinder mounting lug (PN 1050-12-001) into the top plate next to the LH top brake band lug weldment (see illustration 3.H.3).*
56. *Install the door pivot shoulder bushings (PN 101-0110) in the door weldment assembly (PN 1050-C4-10) (see Pp. 5.28- 5.29 for correct bushing orientation).*
57. *If not already done, install the remaining support roller assembly less the shaft and fasteners between the body plates in the door pivot location.*
58. *Align the pivot holes in the door weldment with the pivot holes in the top and bottom plates. Slide a 1-1/8" narrow flat washer on to the door pivot roller shaft (PN 101-3940) and insert the shaft through the door bushings, support roller components, and body plates. Once the shaft is fully inserted (it may need to be lightly tapped) secure with a 1" narrow flat washer and 1" UNS thin nylock nut.*
59. *Thread a 1/2" UNC hex nut on to a 1/2" UNC x 1-3/4" hex bolt. Thread the hex bolt in to the threaded hole on the front of the door weldment.*
60. *Refer to Pp. 5.32 - 5.33 for a door assembly illustration. Lightly grease the door latch adjustment cam (PN 1037-A-14). Position the door latch weldment (PN 1050-15) at the front of the door weldment, and insert the two latch springs (PN 997-16) between the latch weldment and the door weldment. Press the latch weldment against the door weldment until the latch pivot holes align, and insert the door latch cam shaft. Secure the latch adjustment cam to the top plate of the door weldment with a 3/8" UNC x 3/4" hex bolt and 3/8" lock washer.*

Assembly Procedure (continued...):

61. *Install mechanical door stop (PN 101-1833) to the bottom plate of the tong next to the LH brake band retainer weldment. Secure with two 3/8" UNC x 2" bolts and 3/8" lock washers.*
62. *Install the door spring cylinder (PN 101-0069) using two 1/2" x 1/2" hex socket shoulder bolts (UNC).*
63. *Install upper and lower lined brake band weldments (PN 1050-D4-29). Secure each brake band to the top or bottom plate with a brake band retainer (PN 101-0140),and 3/8" NC x 1" hex bolts and 3/8" lock washers. Attach the fronts of each brake band weldment to the brake band lug weldments with 3/8" UNC x 1-1/2" hex bolts, 3/8" narrow flat washers, and 3/8" UNC hex nylock nuts. These nut and bolt sets are used for adjusting the brake band tension.*
64. *Install the safety door switch assembly using the following procedure (see Pp. 5.30 - 5.31):*
    - i. *Attach safety door latch spacer (PN 101-1411) to the top of the door weldment using two 3/8" UNC x 1" hex socket head cap screws and 3/8" lock washers.*
    - ii. *Attach safety door latch block (PN 101-1104) to the latch spacer using four 3/8" x 1/2" UNC shoulder bolts.*

CE *CE-marked tongs only: attach safety door latch block (PN 101-1104) to the latch spacer using four 3/8" x 1/2" UNC wire-drilled shoulder bolts*

    - iii. *Attach safety door latch block (PN 101-1103) to safety door latch plate (PN 101-1410) using three 3/8" NF x 1" flat head countersunk cap screws.*
    - iv. *Place the safety door latch plate (PN 101-1410) onto the bottom plate of the safety switch base and guard weldment (PN 101-1475) and align the bolt holes. Secure to the top plate using two 3/8" UNC x 3" hex bolts and lock washers, and one 3/8" UNC x 1-1/4" hex bolt and lock washer. Note that the two longer cap screws in this step replace two of the tong's perimeter fasteners.*

CE *CE-marked tongs only: secure safety door latch plate (PN 101-1410) and guard weldment (PN 101-1475) to the top plate using two 3/8" UNC x 3" wire-drilled hex bolts and lock washers, and one 3/8" UNC x 1-1/4" wire-drilled hex bolt and lock washer.*

    - v. *Insert load plunger (PN AE12-306) into LH safety door latch block (PN 101-1103).*
    - vi. *Attach three 1/4" NPT x 1/4"JIC elbows (PN 08-0284) to the Deltrol safety door valve (PN 08-0337M). Position a 15/16" valve lock nut (PN 09-0278) as shown in illustration 3.H.9, and secure the safety door valve to the safety door latch block using the valve lock nut.*

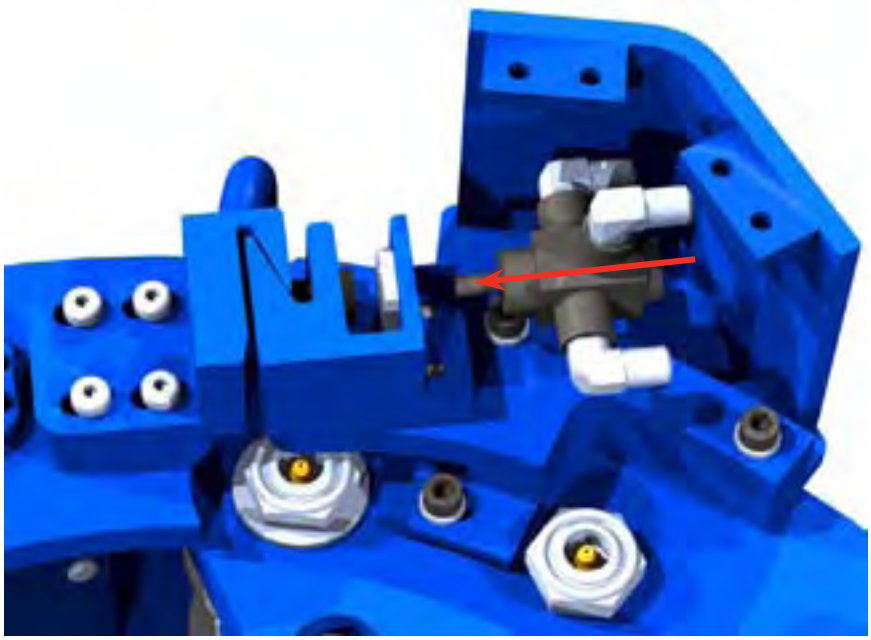


ILLUSTRATION 3.I.9: TONG ASSEMBLY - SAFETY DOOR VALVE INSTALLATION

Assembly Procedure (continued...):

vii. *Attach the top plate of the switch guard (PN 101-1474) to the switch guard weldment using three 3/8" UNC x 1" hex bolts and 3/8" lock washers.*

NOTE: See Section 3.F.4 for information on correctly adjusting the safety door switch.

CE *CE-marked tongs only: secure top plate of the switch guard (PN 101-1474) to the switch guard weldment using three 3/8" UNC x 1" wire-drilled hex bolts and lock washers.*

65. *Install the LH & RH rigid sling mounting lugs (LH = PN 101-0113, RH = PN 101-0115) using two 3/8" UNC x 1-3/4" hex bolts and 3/8" lock washers, and two 1/2" UNC x 1-1/4" hex bolts and lock washers per side.*

CE *CE-marked tongs only: secure LH & RH rigid sling mounting lugs to the top plate using two 3/8" UNC x 2" wire-drilled hex bolts and 3/8" lock washers, and two 1/2" UNC x 1-1/4" wire-drilled hex bolts and lock washers per side.*

66. *Slide the master lifing link (PN 02-0516) over the adjustment helix (PN 1053-1-H), and install the adjustment helix in the rigid sling weldment (PN 101-0112) using a 3/4" UNC x 8" hex bolt and 3/4" UNC nylock nut.*

CE *CE-marked tongs only: rigid sling weldment for CE-marked tong = PN 101-0112-CE*

67. *Use a crane to hoist the rigid sling weldment. Connect the rigid sling weldment to the rigid sling mounting lugs with rigid sling pins (PN 1053-C-1C). Secure each pin with two 0.148" x 2.938" hitch pins.*
68. *Thread a 3/4" UNC hex nut on to each of two rigid sling leveling adjustment weldments (PN 1053-C-1L). Thread the leveling adjustment weldments into the front of the rigid sling weldment mounting brackets, roughly adjusting them so the rigid sling is approximately perpendicular to the top plate of the tong (see illustration 3.H.10).*
69. *Thread 1/2" UNC hex nuts on to two 1/2" UNC x 1-3/4" hex bolts. Thread the bolts into the rear of the rigid sling weldment mounting brackets. (see illustration 3.H.10).*

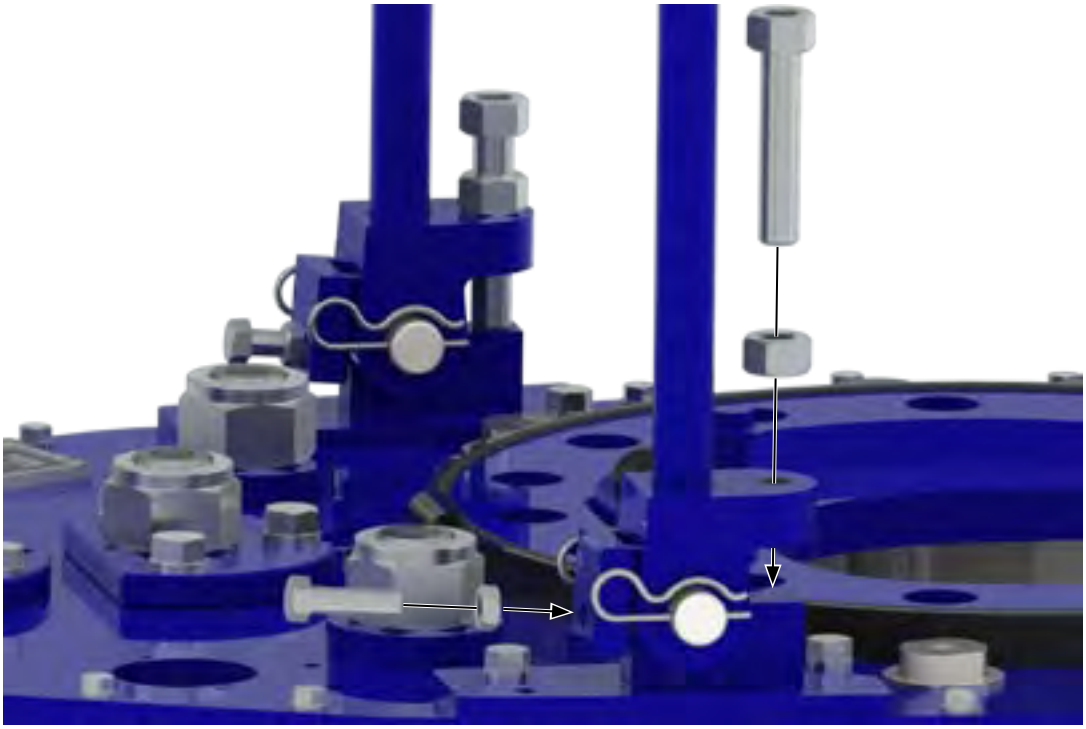


ILLUSTRATION 3.I.10: TONG ASSEMBLY - RIGID SLING ADJUSTMENT BOLT INSTALLATION

Assembly Procedure (continued...):

70. *Attach the rear leg weldment (PN 997-D8-160A) to the bottom plate of the tong using a 7/8" UNC x 1" hex socket head cap screw and a regular 7/8" flat washer.*
71. *Install grease fittings:*
    a) *Install one 1/4" straight thread grease fitting (PN 02-0097) into the top side of each support roller shaft, including the door pivot rollers (12 locations total).*
    b) *Install one 1/4" straight thread grease fitting (PN 02-0097) into the top side of the latch adjustment cam.*
    c) *Install one 1/8" NPT grease fitting (PN 02-0005) into the top of each rotary idler shaft (two locations total).*
    d) *Install two 1/8" NPT 90° grease fittings (PN 02-0093) into the top of the pinion idler half-shaft.*
    e) *Install one 1/8" NPT grease fitting (PN02-0005) into the end of the clutch shaft, in the centre of the clutch bearing cap.*
    r) *Install two 1/8" NPT 90° grease fittings (PN 02-0093) in each pinion bearing cap (four locations total).*
    g) *Install two 1/8" NPT 90° grease fittings (PN 02-0093) in clutch bearing cap (two locations total).*
    h) *Install one 1/8" NPT 90° grease fitting (PN 02-0093) or one 1/8" NPT 45° grease fitting (PN 02-0006) in the top of the motor mount.*
    i) *Install drive-in grease fittings (PN 02-0012) into the ends of each cage plate cam follower (26 locations total).*
72. *Install hydraulic inlet support base (PN 101-1138) to the top plate directly adjacent to the RH rotary idler, using two 3/8" UNC x 1" hex bolts and 3/8" lock washers. Attach the adjustment plate (PN 101-0022) to the support base using two 3/8" UNC x 1" hex bolts, 3/8" narrow flat washers, and 3/8" UNC hex nylock nuts.*
73. *Attach the outlet coupling support mounting base (PN 101-0021) to the top plate on the RH side of the motor mount using four 3/8" UNC x 2" hex socket head cap screws.*
74. *Attach the outlet coupling support weldment (PN 101-0023) to the weldment mount using two 3/8" UNC x 1" hex bolts and 3/8" lock washers. Attach the adjustment plate (PN 101-0277) to the outlet support weldment using four 3/8" UNC x 1" hex bolts, 3/8" narrow flat washers, and 3/8" UNC hex nylock nuts.*
75. *Coat the threads of the hydraulic valve mounting posts (PN 101-0116) with Loctite™ and thread into the top plate just behind the brake band on either side of the brake band retainer.*
76. *Mount the DVA35 hydraulic valve assembly on the mounting posts using two 1/2" UNC x 4-1/2" hex bolts and 1/2" narrow flat washers.*

CE *CE-marked tongs only: Install the valve handle guard weldment (PN CE-HANDLE-2) over the valve handles while securing the valve bank to the supports (see illustration 3.I.11 next page).*

Assembly Procedure (continued...):

ILLUSTRATION 3.I.11: TONG ASSEMBLY - VALVE HANDLE GUARD INSTALLATION (CE MARKED TONGS)

78. *Attach two #20 (1-1/4") / 1" JIC flange elbows (PN 02-9216) to the motor using #20 split flange kits (PN 02-9217).*
79. *Connect the safety door valve block (PN 101-0727) directly to the flange elbows on the hydraulic motor (the block will sit on top of the motor following installation). Connect the rotation control valve on the DVA35 valve assembly to the safety door block.*
80. *Connect the safety door switch to the safety door block and hydraulic valve assembly. Refer to hydraulic schematic, or call McCoy Drilling & Completions | Farr engineering department for assistance.*
81. *Install desired jaw die kit in the tong using the jaw pivot bolts (PN 1050-C5-28).*

J. DAILY INSPECTION & MAINTENANCE CHECKLIST (POWER TONG)

Farr recommends that the following inspection and maintenance procedures be performed before each use, and at least once per day when the tong is in steady use, in the order in which they are listed.

1. ☐ *Rotate cage plate/rotary gear until the opening in the rotary gear faces towards the rear of the tong.*

DO NOT PERFORM ANY FURTHER ACTIONS OR MAINTENANCE WHILE THE TONG IS CONNECTED TO ANY HYDRAULIC POWER SUPPLY. FARR RECOMMENDS THAT ALL HYDRAULIC LINES ARE FULLY DISCONNECTED, AND RESIDUAL HYDRAULIC PRESSURE IS BLED OFF. ENSURE ADEQUATE CONTAINMENT IS IN PLACE TO PREVENT ENVIRONMENTAL CONTAMINATION FROM RESIDUAL HYDRAULIC FLUID.

DEPRESSURIZE HYDRAULIC SYSTEM IN PREPARATION FOR MAINTENANCE:

2. ☐
   1) *Rotate the tong to the "open throat" position. Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder*
   2) *De-energize the power unit.*
   3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
   4) *Remove the hydraulic SUPPLY line from the equipment.*
   5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
   7) *Disconnect the hydraulic RETURN line from the equipment.*
   8) *Disconnect remaining hoses such as case drains.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES

3. ☐ *Perform an initial wash of the tong in order to remove the majority of dirt and grease build-up. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid and dirty grease.*
4. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
5. ☐ *Use a flashlight to perform a visual inspection of the gear train through the access panel and the opening of the rotary gear. If gear damage or chips of metal are seen, the tong should be removed from service and overhauled to avoid further damage. Replace access panel when inspection is complete.*
6. ☐ *Perform a visual inspection of all fasteners and protruding body pieces (example: hydraulic valve mounts, inlet & outlet line supports, tong legs, shifter handle pivot lugs). Tighten or replace loose or missing fasteners. Farr recommends that damaged or missing body parts be repaired or replaced.*
7. ☐ *Inspect the jaws and dies. Inspect the jaw roller pins for signs of damage - replace pins if necessary. If the pins are welded in place, replace the entire jaw assembly. Ensure dies are secure in the jaw - replace worn dies if necessary. Ensure that the jaw rollers rotate freely. Check to ensure the size of the loaded jaws match the size of casing or pipe you are running.*
8. ☐ *Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service.*
9. ☐ *Inspect tong for signs of premature wear, or moving parts that are rubbing (bare metal where there used to be paint is a good indication of wear.*
10. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*
11. ☐ *Inspect top and bottom brake band linings - replace if necessary. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*
12. ☐ *Perform a visual inspection of all hydraulic lines. Replace flexible lines if they appear to be cracked, fatigued, or have visible signs of wear from contact with a rigid object.*

13. ☐ *Perform a complete greasing of the tong - refer to Maintenance section of the technical manual*

14. ☐ *Ensure main supply and return connections to the tong are fully made up. Re-connect the remainder of the hydraulic lines, and, if applicable, the electrical line to the turns counter.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

15. ☐ *Perform a visual inspection of the load cell. If using a tension load cell, replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression. Inspect hydraulic line, fittings, and diaphragm seals for fluid leaks.*

16. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*

If using a stand-alone power unit, start it now - refer to the power unit technical manual for startup procedures. Listen to power unit for a moment to see if there are any unusual mechanical sounds (rubbing, grinding, excessive pump noise). If using a diesel unit, allow sufficient time for the engine to reach operating temperature before increasing engine RPM. Once engine is warm, gradually increase engine RPM until operating speed is reached.

17. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*

18. ☐ *Perform a visual inspection of pressurized hydraulic lines. Document and correct any hydraulic fluid leaks.*

19. ☐ *Perform a full functional test of the tong (refer to section 2.I.4).*

20. ☐ *Test safety door feature (if equipped). Open the tong door(s), and attempt to rotate the cage plate at low speed (low gear) in both directions (makeup and breakout). If cage plate begins rotating, the safety door mechanism is not functional, and the tong must be removed from service until the safety door mechanism can be repaired. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR

21. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved.*

CE *CE-marked tongs only: Inspect all wire-ties on drilled bolts on critical safety systems. All wiring must be intact and appear tamper-free. Check the integrity of all guards, including the rubber protective washers over the backup leg openings.*

K. MONTHLY MAINTENANCE CHECKLIST - POWER TONG

The following maintenance checklist is intended as a guideline rather than a definitive maintenance schedule. Your equipment may require more, or less, maintenance depending upon the frequency of use, the percentage of maximum torque that your equipment is routinely subjected to, and the field conditions under which your equipment operates. Farr recommends that the following inspection and maintenance procedures be performed monthly, or in conjunction with your maintenance foreman's experience and best estimate of when your equipment is due for this maintenance.

1. ☐ *Rotate cage plate/rotary gear until the opening in the rotary gear faces towards the rear of the tong.*

DO NOT PERFORM ANY FURTHER ACTIONS OR MAINTENANCE WHILE THE TONG IS CONNECTED TO ANY HYDRAULIC POWER SUPPLY. FARR RECOMMENDS THAT ALL HYDRAULIC LINES ARE FULLY DISCONNECTED, AND RESIDUAL HYDRAULIC PRESSURE IS BLED OFF. ENSURE ADEQUATE CONTAINMENT IS IN PLACE TO PREVENT ENVIRONMENTAL CONTAMINATION FROM RESIDUAL HYDRAULIC FLUID.

DEPRESSURIZE HYDRAULIC SYSTEM IN PREPARATION FOR MAINTENANCE:

1) *De-energize the power unit.*
2) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*

2. ☐

3) *Remove the hydraulic SUPPLY line from the equipment.*
4) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
5) *Disconnect the hydraulic RETURN line from the equipment.*
6) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES

3. ☐ *Clean the exterior of the tool thoroughly, using either water (if using a pressure washer ensure a low-pressure wash wand is used), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents.*

4. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*

5. ☐ *Clean the interior of the tong thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents. Make a note if any metal shavings or metal pieces are flushed out of the gear train cavity - if shavings or metal pieces are seen the tong must be overhauled before it is returned to service.*

6. ☐ *Inspect all fasteners and fastener safety wires (if equipped). Replace any missing fasteners - use Grade 8 bolts only unless otherwise specified. Re-torque all external fasteners to SAE specifications.*

7. ☐ *Repair or replace any damaged or missing external body parts, such as torque gauge mounts, hydraulic supports, safety door protectors, etc.*

8. ☐ *Perform a visual inspection of all fasteners and protruding body pieces (example: hydraulic valve mounts, inlet & outlet line supports, tong legs, shifter handle pivot lugs). Tighten or replace loose or missing fasteners.*

9. ☐ *Inspect tong for signs of premature wear, or moving parts that are rubbing (bare metal where there used to be paint is a good indication of wear.*

10. ☐ *Inspect all paint - locations in which the paint has been damaged must be repaired prior to the tong being returned to service. Prepare areas to be painted to ensure they are free of grease, dirt, or solvent. Touch up using a solvent-based acrylic paint - "McCoy Grey" is paint color number RAL7015, "McCoy Yellow" (hazard areas) is RAL1007, and McCoy Green is RAL6029 (contact Farr sales for paint number for custom paint applications). Allow sufficient time for paint to dry before proceeding.*

11. ☐ *Visually inspect all load-bearing welds. Any weld that is cracked or separating must be repaired and repainted before returning the tong to service.*

12. ☐ *Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service. Refer to Section 2A of the technical manual (Sling/Load Bearing Device Safety) for information on recommended testing and recertification. Please note that turnbuckles with part number 101-3086 (short turnbuckles) use a high-strength pin which must be supplied by Farr.*

"SHORT" TURNBUCKLES HAVING PART NUMBER 101-3086 EMPLOY HIGH-STRENGTH PINS WHICH MUST BE SUPPLIED BY FARR.

13. ☐ *Remove hydraulic motor and rotate the gear train by hand, and use a flashlight to perform a visual inspection of the gear train through the access panel and the opening of the rotary gear while the gear train is being rotated. If gear damage or chips of metal are seen, the tong should be removed from service and overhauled to avoid further damage. Replace access panel when inspection is complete.*

14. ☐ *Inspect all jaws and dies in use for the maintenance interval. Remove pin & roller, and inspect for signs of damage - replace pins if necessary. If the pins are welded in place & the welds are found to be damaged, remove and quarantine the jaw until the weld is repaired. Clean the pins and rollers, and reassemble using a liberal coating of anti-seize compound. Ensure dies are secure in the jaw & die retainers are present. Replace worn dies if necessary. Ensure that the jaw rollers rotate freely.*

15. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*

16. ☐ *Inspect top and bottom brake band linings - replace if lining is found to be flaking or is missing pieces of material. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*

17. ☐ *Inspect door springs. Ensure the springs retain sufficient strength to be able to assist the opening of the door, and to keep the door open. The springs should also help to "snap" the door shut.*

18. ☐ *Inspect backup springs (if applicable). The rear extension springs (where used) should be equally extended, and the front leg springs should be equally compressed. Ensure that neither of the rear backup springs have been overextended and lack sufficient tension to adequately support the backup. Ensure that neither of the front leg springs (or, when installed, the single rear backup leg spring) have been over-compressed, and still retain enough spring strength to support the front of the backup.*

19. ☐ *Extend all hydraulic cylinders, and inspect cylinder rods for signs of mechanical damage, flaking, or rust. Farr recommends that damaged cylinders be replaced prior to storage.*

20. ☐ *Perform a visual inspection of all hydraulic lines. Replace flexible lines if they appear to be cracked, fatigued, or have visible signs of wear from contact with a rigid object. If your tong is equipped with rigid hydraulic lines, replace any line that is dented or appears to be stressed or cracked.*

21. ☐ *Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear. Perform a full lubrication - refer to Maintenance section of manual to determine lubrication points.*

22. ☐ *Ensure main supply and return connections to the tong are fully made up. Re-connect the remainder of the hydraulic lines.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

If using a stand-alone power unit, start it now - refer to the power unit technical manual for startup procedures. Listen to power unit for a moment to see if there are any unusual mechanical sounds (rubbing, grinding, excessive pump noise). If using a diesel unit, allow sufficient time for the engine to reach operating temperature before increasing engine RPM. Once engine is warm, gradually increase engine RPM until operating speed is reached.

23. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*

24. ☐ *Perform a visual inspection of pressurized hydraulic lines. If any hydraulic fittings or hoses are leaking they must be repaired or replaced before proceeding.*

25. ☐ *Rotate tong for one minute in both high and low gear. Stop the tong and reverse the direction of rotation for another minute in both high and low gear, ending with the opening of the rotary gear facing the gear train. De-energize the power unit, and perform another generous lubrication of the gear train, including the gear housing.*

26. ☐ *Energize power unit. Rotate tong for one minute in both high and low gear. Stop the tong and reverse the direction of rotation for another minute in both high and low gear, ending with the opening of the rotary gear facing the gear train.*

27. ☐ *De-energize the power unit, and perform a third generous lubrication of the gear train, including the gear housing.*

28. ☐ *Rotate tong in low gear for 5 minutes while monitoring pressurized seals and hydraulic lines. If a seal, line, or fitting begins to leak while tong is rotating, it must be replaced before the equipment is returned to service.*

29. ☐ *Rotate tong in high gear for 5 minutes while monitoring temperature of top and bottom bearing caps. If the bearing caps are hot to the touch (higher than approximately 50°C) replace the applicable bearings. Likewise if the tong is making unusual noises check for damaged bearings (see Maintenance Manual for all bearing locations).*

30. ☐ *Install load cell. If using a tension load cell, perform a visual inspection and replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression. Inspect load cell for damage or signs of stress. Check oil level in load cell and fill if necessary (refer to technical manual Section 7 or Section 8).*

31. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*

32. ☐ *If applicable, the weld securing the single load cell anchor to the bridge bar main plate must be inspected (compression load cell only). If the integrity of the weld has been compromised, the tong must be removed from service until the weld is repaired. The load cell beam will need to be disconnected and removed so the weld is visible. Before re-installing the beam, liberally grease the anchor pin before reinserting into the load cell beam.*

33. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*

34. ☐ *Perform a full functional test of the tong including, if applicable, backup components, lift cylinder, and float frame components (refer to Section 2.I.4). Report and correct any hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are used.*

35. ☐ *Test safety door feature (if equipped). Begin rotating the tong at low speed, and open the tong door(s). If rotation does not immediately stop, this is an indication that the safety door mechanism is not operating correctly and the tong must be removed from service until the mechanism is repaired. Repeat the test while operating the tong in the opposite direction. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR

36. ☐ *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external unpainted surfaces (and chain slings) EXCEPT cylinder rods, jaw rollers, and rotary gear camming surfaces. Refer to manufacturer data sheets for proper application and safety information.*

Once all of the above maintenance checklist items have been satisfactorily completed the tool may be returned to service.

L. TUBULAR CONNECTION EQUIPMENT DE-COMMISSIONING & SHIPPING PROCEDURE

Perform the following decommissioning procedures when removing tubular connection equipment from service, with the intent of short to long-term storage. These procedures are essential for ensuring proper protection of the equipment from environmental attack, and to aid in the quick turnaround when returning the equipment to service.

Store all o-rings, seals, packings, gaskets, etc. in strong moisture proof, airtight containers. Ensure that these items are not crushed, nicked, or otherwise damaged.

Do not perform any further actions or maintenance while the tong is connected to any hydraulic power supply. Farr recommends that all hydraulic lines are fully disconnected, and residual hydraulic pressure is bled off. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid.

IN ORDER TO MAINTAIN THE INTEGRITY OF INSTALLED SEALS, MCCOY RECOMMENDS THAT THE MAXIMUM STORAGE INTERVAL NOT EXCEED ONE YEAR. AT LEAST ONCE PER YEAR ALL TUBULAR CONNECTION IN LONG-TERM STORAGE SHOULD BE RECOMMISSIONED AS PER SECTION 3.M. IF FURTHER STORAGE IS REQUIRED, THE EQUIPMENT SHOULD THEN BE PUT THROUGH ANOTHER DE-COMMISSIONING PROCEDURE.

DEPRESSURIZATION PROCEDURE IN PREPARATION FOR STORAGE:

1) *Rotate the tong so that the opening in the rotary gear faces the gear train (towards the rear of the tong). Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder (if equipped). If mounted in a frame, retract the float cylinders (if equipped).*
2) *De-energize the power unit.*
3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
4) *Remove the hydraulic SUPPLY line from the equipment.*
5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Disconnect the hydraulic RETURN line from the equipment.*
8) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE-INDUCED INJURIES

1. ☐ *Perform an initial wash of the tool in order to remove the majority of dirt and grease build-up. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid and dirty grease.*
2. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
3. ☐ *Clean the interior of the tong thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents. Make a note if any metal shavings or metal pieces are flushed out of the gear train cavity - if shavings or metal pieces are seen the tong must be overhauled before it is returned to service.*
4. ☐ *Clean the exterior of the tool thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents.*
5. ☐ *Inspect all fasteners and fastener safety wires. Replace any missing fasteners - use Grade 8 bolts only. Re-torque all external fasteners to SAE specifications.*
6. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*
7. ☐ *Repair or replace any damaged or missing external body parts, such as torque gauge mounts, hydraulic supports, safety door protectors, etc.*
8. ☐ *Inspect all paint - locations in which the paint has been damaged must be repaired prior to storage. Prepare areas to be painted to ensure they are free of grease, dirt, or solvent. Touch up using a solvent-based acrylic paint - "McCoy Grey" is paint number RAL7015. Allow sufficient time for paint to dry before proceeding.*
9. ☐ *Perform a liberal lubrication of the equipment - refer to Maintenance section of manual to determine lubrication points. Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear.*
10. ☐ *Connect the equipment to a hydraulic power unit. Ensure all lines are fully made up to prevent equipment damage from excessive back pressure. Do not neglect to connect the motor drain.*

11. ☐ *Energize power unit.*

12. ☐ *Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train. De-energize the power unit, and perform another generous lubrication of the gear train, including the gear housing.*

13. ☐ *Energize power unit. Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train.*

14. ☐ *De-energize the power unit, and perform a third generous lubrication of the gear train, including the gear housing.*

15. ☐ *Energize power unit, and rotate the tong for a final time, one minute in one direction, stop, and reverse the direction of rotation for another minute, this time ending with the rotary gear in the "open throat" position.*

16. ☐ *Extend all hydraulic cylinders, and inspect cylinder rods for signs of mechanical damage, flaking, or rust. Farr recommends that damaged cylinders be replaced prior to storage.*

17. ☐ *If you are using a frame-mounted tool, the tong must be lowered onto the backup in order to remove the risk of sudden and catastrophic movement when pressure is removed from the float cylinders. Cover the top of the backup with protective cloth to protect the paint on the backup. Place two wooden beams across the top of the tong, ensuring that the beams have a minimum size of 4" x 4" x the width of the tong. Cover the tops of the wooden beams with more protective cloth to prevent paint damage to the tong. When lowering the tong onto the beams, ensure that the beams come into flat contact with the bottom of the tong, away from bearing caps, brake bands, or other protrusions on the bottom of the tong. Ensure that the tong hanger chains are loose, but not dangling into contact with the hangers or top plate of the tong.*

DEPRESSURIZATION PROCEDURE FOR STORAGE:

1) *Rotate the tong to the "open throat" position.*
2) *Exercise each hydraulic cylinder several times - open the tong and backup doors (if equipped), retract and extend the remote backing pin ramp (if equipped), retract and extend the float cylinders. Leave all cylinders except for the door cylinders in their fully retracted position. The general idea is to have as little of the chrome cylinder rods exposed as possible.*
3) *De-energize the power unit.*
4) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
5) *Remove the hydraulic SUPPLY line from the equipment.*
6) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Connect a low-pressure air supply line (10 PSI or less) to the hydraulic supply line, and force a small amount of the remaining hydraulic fluid from the valve assembly - this will allow for thermal expansion of the hydraulic fluid if the equipment is stored or transported in high ambient temperatures. Failure to do this may result in damaged or destroyed seals in the equipment.*
8) *Disconnect the hydraulic RETURN line from the equipment.*
9) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

18. ☐ *If any hydraulic fittings or hoses are leaking they must be repaired or replaced before proceeding.*

19. ☐ *Wipe all excess grease from outside of equipment. Replace the access door panel. Use a solvent-based cleaner on rags to wipe all external surfaces to remove residual grease or hydraulic fluid. Once the outside surfaces have been degreased, wipe all external surfaces with clean water to remove residual solvent.*

20. ☐ *Farr recommends that chain slings be removed and stored separately. Rigid slings and other rigid suspension devices may remain in place.*

21. ☐ *Apply grease or heavy oil to all exposed cylinder rods.*

22. ☐ *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external surfaces EXCEPT cylinder rods (including chain slings). Refer to manufacturer data sheets for proper application and safety information.*

DO NOT ALLOW ANTI-CORROSIVE AGENTS TO CONTACT CYLINDER RODS. CYLINDER ROD DAMAGE WILL OCCUR.

23. ☐ *Allow the anti-corrosive coating ample time to dry - refer to manufacturer data sheets for drying times at room temperature.*

24. ☐ *Wrap entire assembly in 100 gauge (1 mil) corrosion-inhibiting wrap, at least 3 layers thick. Attempt to ensure that the tool is well-sealed within the wrapping, including the bottom.*

If possible, store in a sealed, climate controlled environment. If isolated storage is not available, Farr recommends storing your wrapped equipment in a secure, out-of-the-way location, using silica gel desiccant to reduce the humidity within the wrapping. As a guideline, use 125 g. of desiccant for each cubic metre of space, or 3.5 g. per cubic foot.

CALCULATION OF REQUIRED DESICCANT

1) *Calculate the trapped air volume by measuring the outside dimensions of the tool to be stored, and treat that as the volume to be stored. For example, the external dimensions of a KT20000 20" power tong are 80.25" x 50.5" x 28", which calculates to an approximate volume of 113500 in^3, or 66 ft^3 (1.87 m^3).*

2) *Multiply the calculated air volume, in cubic feet, by the recommended amount of desiccant per cubic foot. Carrying forth the example used in the previous step, the required desiccant charge would be 3.5 g. x 66 ft^3, equaling 231 g. Several manufacturers offer silica gel desiccant in packaged quantities of 125 grams per bag, so two packages of desiccant would be required. Please keep in mind that this is a guideline only - more or less desiccant may be required in extreme environmental conditions.*

For best corrosion resistance the equipment should be removed from storage and exercised on a regular basis, depending on the storage environment. Farr recommends that for equipment stored in a salt-water maritime or exposed dusty environment, repeat steps 9 through 24 monthly. For equipment stored in isolated storage in a non-maritime environment, repeat steps 9 through 24 quarterly. Replace desiccant packs at this time - depleted desiccant packs may be treated as regular dunnage.

SHIPPING INSTRUCTIONS

The following procedure lists the steps to be followed to prepare your tong for shipping.

1. *If not already done remove accessories (tong jaws, load cell, torque gauge, etc.) McCoy recommends wrapping these items in protective wrap and placing in a separate wooden crate.*

2. *Place the equipment on a sturdy pallet constructed of 4" x 4" cross-members and 2" x 4" flooring. McCoy recommends placing a 2" x 6" board across the width of the tong under the legs (see Illustration 3.M.1). Ensure the pallet is large enough to accommodate the wooden crate containing the tong accessories.*

ILLUSTRATION 3.L.1: SHIPPING INSTRUCTIONS - PALLET

SHIPPING INSTRUCTIONS (CONTINUED):

3. *Use a crane to support the chain sling (if equipped). Wrap the chain sling with bubble wrap or another similar protective wrapping, and secure the wrapping with tape. Lower the wrapped chain sling so it sits inside the opening of the tong.*

ILLUSTRATION 3.M.2: SHIPPING INSTRUCTIONS - WRAPPING CHAIN SLING & STRAPPING TO PALLET

4. *Securely strap the equipment in place using metal strapping (see Illustration 3.L.2). Place strapping as close to the cross-members under the equipment legs as possible, and use caution not to entrap any flexible hydraulic hoses beneath the strapping (guide strapping through beneath the hydraulic hoses). Use the following guidelines to determine the strapping requirements:*

   Assemblies weighing 1000 lbs. (454 kg.) or less:

      3/4" x 0.029" metal strapping, 3320 lbs. (1509 kg.) tensile strength
      Minimum two straps

   Assemblies weighing more than 1000 lbs. (454 kg.) or less:

      1-1/4" x 0.031" metal strapping, 5500 lbs. (2500 kg.) tensile strength
      *Minimum **two** straps for assemblies weighing less than 5000 lbs. (2273 kg.)*
      *Minimum **three** straps for assemblies weighing more than 5000 lbs. (2273 kg.)*

   Before tightening strapping, place strapping protectors wherever the metal strapping comes into contact with the equipment.

   Place the wooden crate containing the tong accessories on the crate next to the equipment. Strap the crate to the pallet using 3/4" x 0.029" metal strapping. If it is not practical to place larger loose items in a wooden crate, ensure they are also securely strapped to the pallet using 3/4" x 0.029" metal strapping.

5. *Use a large polyethylene shipping bag (sometimes called a pallet cover) to completely enclose the equipment. Seal polyethylene bag to the pallet using 1 mil polyethylene wrap. Use the wrap to conform the plastic cover to the general shape of the equipment, but do not wrap so tight that sharp edges on the equipment perforate the cover.*

6. *McCoy recommends enclosing the equipment in a sturdy shipping crate which is securely fastened to the pallet.*

M. TUBULAR CONNECTION EQUIPMENT RE-COMMISSIONING PROCEDURE

Perform the following recommissioning procedures when removing tubular connection equipment from short or long-term storage back into regular service. These procedures are essential for ensuring proper equipment preparation and operation. The following procedures also assume that the decommissioning and storage procedures recommended by Farr have been strictly observed.

1. ☐ *Remove all protective plastic wrapping. If there are desiccant packs with the assembly, they may be disposed of with the regular garbage.*
2. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
3. ☐ *Wipe excess grease or heavy oil from exposed cylinder rods.*
4. ☐ *If applicable, re-connect chain sling to lifting lugs. Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service. If your company requires yearly certification of lifting equipment, ensure that the most recent test date falls within the past year. Perform recertification if necessary.*
5. ☐ *Perform a liberal lubrication of the equipment - refer to Maintenance section of manual to determine lubrication points. Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear.*
6. ☐ *Connect the equipment to a hydraulic power unit. Ensure all lines are fully made up to prevent equipment damage from excessive back pressure. Do not neglect to connect the motor drain.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

7. ☐ *Energize power unit.*
8. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*
9. ☐ *Perform a thorough inspection of pressurized hydraulic lines and fittings. Any leaking hydraulic fluid lines or fittings must be replaced before the equipment is returned to service.*
10. ☐ *Perform a thorough inspection of all seals. Any seal that is leaking or "weeping" must be replaced before the equipment is returned to service.*
11. ☐ *Rotate tong in low gear for 5 minutes while monitoring pressurized seals and hydraulic lines. If a seal, line, or fitting begins to leak while tong is rotating, it must be replaced before the equipment is returned to service. Finish this step with the rotary gear opening facing the gear train. De-energize the power unit.*
12. ☐ *Inspect all flexible hydraulic lines for signs of wear, blistering, or any other signs of potential failure - replace if signs of potential failure are identified.*
13. ☐ *Inspect the gear train housing. If the amount of grease is inadequate, liberally grease the gear train through the access panel, and through the opening in the rotary gear.*
14. ☐ *Inspect top and bottom brake band linings - replace if necessary. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands. Ensure that all grease is wiped from brake band linings and the parts of the cage plates that come into contact with the brake band linings*
15. ☐ *Re-install access panel. Install a set of pre-inspected jaws that are the correct size for the pipe or casing being run.*
16. ☐ *Install load cell. If using a tension load cell, perform a visual inspection and replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression.*
17. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*
18. ☐ *If applicable, the weld securing the single load cell anchor to the bridge bar main plate must be inspected (compression load cell only). If the integrity of the weld has been compromised, the tong must be removed from service until the weld is repaired. The load cell beam will need to be disconnected and removed so the weld is visible. Before re-installing the beam, liberally grease the anchor pin before reinserting into the load cell beam.*
19. ☐ *Re-energize power unit.*

20. ☐ *Perform a full functional test of the equipment including, if applicable, backup components and float frame components. Report and correct any hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are used.*

21. ☐ *If using a frame-mounted tong and backup system, raise the tong off the beams that it is resting upon. Remove the beams and protective cloths - inspect the paint on top of the backup and the bottom of the tong to ensure it has not been damaged by the beam.*

22. ☐ *Test safety door feature (if equipped). Open the tong door(s), and attempt to rotate the cage plate at low speed (low gear) in both directions (makeup and breakout). If cage plate begins rotating, the safety door mechanism is not functional, and the tong must be removed from service until the safety door mechanism can be repaired. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR

23. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved.*

24. ☐ *When all of the previous steps are completed, you may return your re-commissioned equipment to service.*

Adequate maintenance and proper fluid selection is essential for minimizing hydraulic-related failures. All troubleshooting must be performed by a technician trained in hydraulic systems, and familiar with the equipment design, assembly and operation.

The following troubleshooting instructions are intended to be guidelines only. Any faults not solved through the use of this guide should be referred to our engineering department for their evaluation and recommendations.

A. TONG WILL NOT DEVELOP SUFFICIENT TORQUE

1. *Malfunctioning relief valve on tong hydraulic circuit.*

   See Section 4.B, Relief Valve Troubleshooting

2. *POSSIBLE PROBLEM: Directional valve is leaking.*

   SOLUTION: Check directional valve. Neutral position should return fluid directly to the reservoir. Replace or repair valve to ensure correct operation.

3. *POSSIBLE PROBLEM: Power unit is not producing adequate pressure.*

   SOLUTION: Troubleshoot power unit (see user's manual for your particular unit).

4. *POSSIBLE PROBLEM: Poor hydraulic pressure at the tong despite adequate pressure at the power unit, or excessive back pressure in the return line.*

   SOLUTION: Restrictions exist in line between power unit and tong. Inspect integrity of self-sealing couplings to ensure they are allowing full fluid flow. Check to ensure no other restrictions exist (contaminated catch screens or filters, for example).

5. *POSSIBLE PROBLEM: Fluid viscosity is not appropriate (too high or too low).*

   SOLUTION: Ensure hydraulic fluid being used is the viscosity recommended by McCoy Drilling & Completions. Power unit pump may not prime if fluid is too heavy, and the hydraulic system will overheat if fluid is too light. Replace with proper viscosity fluid.

   SOLUTION: Hydraulic fluid viscosity is affected by environmental conditions. Ensure the fluid being used is suitable for high or low temperatures. Replace with proper viscosity fluid for the operating conditions if necessary.

6. *POSSIBLE PROBLEM: Worn or damaged tong motor causing slippage.*

   SOLUTION: Replace or repair worn or damaged motor.

7. *POSSIBLE PROBLEM: Damaged bearings or gears causing excessive drag.*

   SOLUTION: Replace or repair worn or damaged gears or bearings.

8. *POSSIBLE PROBLEM: Jaws slipping on pipe.*

   SOLUTION: Ensure jaw dies are not worn to the point that they cannot grip. Ensure the correct sized jaws are in use.

9. *POSSIBLE PROBLEM: Torque gauge is indicating incorrectly*

   SOLUTION: Incorrect gauge is being used. Ensure gauge is the proper range, and has been properly calibrated for the arm length of the equipment in use.

   SOLUTION: Gauge has been damaged. Check gauge operation and calibration on independent system.

TONG WILL NOT DEVELOP SUFFICIENT TORQUE Cont'd:

10. *POSSIBLE PROBLEM: Load cell is measuring incorrectly.*

    SOLUTION: Incorrect load cell is being used.

    SOLUTION: Air is trapped in torque measuring circuit (load cell, hydraulic line, or gauge. Refer to torque measurement trouble-shooting in Section 6 of this manual.

    SOLUTION: Load cell has been damaged. Replace load cell, or return to McCoy for repair and re-calibration.

FARR CANADA CORP. GUARANTEES CALIBRATION OF A LOAD CELL/TORQUE GAUGE ASSEMBLY FOR A PERIOD OF ONE YEAR. FARR CANADA CORP. SUGGESTS THAT THE LOAD CELL/TORQUE GAUGE ASSEMBLY BE RETURNED TO THE FACTORY FOR RE-CALIBRATION ON A YEARLY BASIS.

B. RELIEF VALVE IS INCORRECTLY SET OR NOT FUNCTIONING

1. *POSSIBLE PROBLEM: Relief pressure set **too low**, resulting in **insufficient tong torque**.*

   *POSSIBLE PROBLEM: Relief pressure set **too high**, resulting in **crushed pipe or gear train failure**.*

   SOLUTION: Adjust setting:

   a. *If your tong is equipped with a system pressure indicator proceed to step "f". If your tong does not have a system pressure indicator, a temporary 0 - 3000 PSI indicator must be installed on the hydraulic inlet.*

   b. *Isolate your tong from hydraulic power, and depressurize following the procedure in section 3.D.*

   c. *Tee in a temporary indicator at the safety door supply pressure port. Ensure all hydraulic connections are performed by a qualified hydraulic technician.*

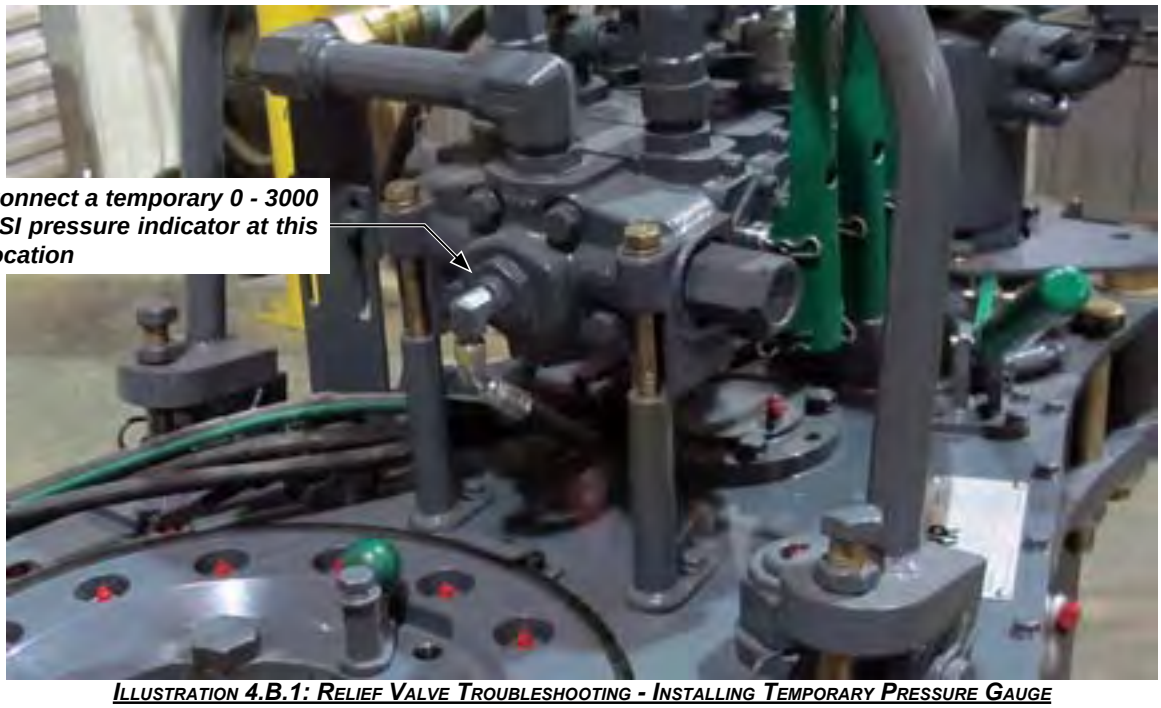


ILLUSTRATION 4.B.1: RELIEF VALVE TROUBLESHOOTING - INSTALLING TEMPORARY PRESSURE GAUGE

   e. *Re-establish hydraulic power to your tong.*

   f. *Loosen the locking nut on the pressure relief valve.*

   g. *Open the tong door to activate the safety door system and inhibit tong rotation.*

   h. *Activate motor control valve. Observe the pressure displayed on the pressure indicator. Adjust the relief valve until the pressure indicated is at the maximum system pressure specified on the specifications page (maximum system pressure is the pressure at which your tong achieves its specified torque).*

DO NOT ADJUST PRESSURE RELIEF TO A SETTING THAT ALLOWS HIGHER THAN MAXIMUM SYSTEM PRESSURE. DOING SO CREATES A POTENTIAL FOR SERIOUS INJURY OR DEATH, AND MAY CAUSE CATASTROPHIC EQUIPMENT FAILURE.

   i. *Release the motor control valve and tighten the locking nut on the pressure relief valve.*

   j. *Isolate your tong from hydraulic power, and depressurize following the procedure in section 3.D.*

   k. *Close the tong door, and remove the temporary pressure indicator. Restore the safety door pressure supply line to factory specifications.*

2. *POSSIBLE PROBLEM: Relief cannot be adjusted to maximum system pressure (high fluid bypass results in low system pressure).*

   SOLUTION: Debris on valve seat, spring is broken, spring has lost spring force due to continuous tension

   a. *Isolate your tong from hydraulic power, and depressurize following the procedure in section 3.D.*

   b. *Loosen the locking nut on the pressure relief valve.*

Continued on next page

RELIEF VALVE IS INCORRECTLY SET OR NOT FUNCTIONING Cont'd:

c. *Use a large flat-head screwdriver to completely unthread the poppet and spring from the relief assembly.*

d. *Inspect the relief valve spring, poppet, and valve seat.*

e. *If no debris is found in relief valve and if seat and poppet are undamaged, replace relief valve spring.*

f. *Reassemble relief valve.*

g. *Relief valve must be re-set to allow maximum system pressure. Follow the procedure in Step 1 of this section to properly adjust relief valve.*

h. *If maximum system pressure still cannot be reached, replace the entire relief valve assembly.*

C. SAFETY DOOR DOES NOT OPERATE OR IS MALFUNCTIONING

1. *POSSIBLE PROBLEM: Safety door switch requires adjustment.*
   SOLUTION: Adjust switch as per section 3.F.4.

2. *POSSIBLE PROBLEM: Safety door switch has failed.*
   SOLUTION: Test safety door switch for proper function and replace if necessary.

3. *POSSIBLE PROBLEM: Contamination in hydraulic lines.*
   SOLUTION: Ensure all three flexible hydraulic lines to safety door switch are free-flowing.

4. *POSSIBLE PROBLEM: Pilot-to-open valve in safety door valve block is malfunctioning.*
   SOLUTION: Remove each valve. Inspect seats and springs. Replace valve(s) if damage is seen on valve seats, or if spring appears to be damaged or broken.

D. TONG RUNNING TOO SLOWLY

1. *POSSIBLE PROBLEM: Obstruction in tong hydraulic circuit preventing adequate flow.*
   SOLUTION: Inspect self-sealing couplings to ensure they are properly engaged.
   SOLUTION: The main hydraulic lines (supply and discharge) to the tong are obstructed. Remove and clean if required.

2. *POSSIBLE PROBLEM: Power unit is not producing adequate flow or pressure.*
   SOLUTION: Troubleshoot power unit (see user's manual for your particular unit).

3. *POSSIBLE PROBLEM: Tong motor is excessively worn and is leaking hydraulic fluid past the vanes.*
   SOLUTION: Replace motor, or rebuild as per Section 7 of this manual.

4. *POSSIBLE PROBLEM: Bearings in gear train and rotary section are excessively worn.*
   SOLUTION: Overhaul tong. See Section 3 of this manual for tong overhaul procedures.

5. *POSSIBLE PROBLEM: Shifter has malfunctioned and the tong is not shifting to high gear.*
   SOLUTION: Inspect and repair shift mechanism as necessary.

6. *POSSIBLE PROBLEM: Two-speed hydraulic motor (if equipped) is not set to correct speed.*
   SOLUTION: Check motor, and set to the correct speed if required.

7. *POSSIBLE PROBLEM: Safety door system is not properly adjusted - hydraulic fluid leak past Deltrol valve.*
   SOLUTION: Check and adjust safety door system.

8. *POSSIBLE PROBLEM: Hydraulic fluid viscosity too high.*
   SOLUTION: Ensure hydraulic fluid meets McCoy Drilling & Completions specifications.
   SOLUTION: Ensure hydraulic fluid is appropriate for climatic conditions, especially during cold-weather operation..

9. *POSSIBLE PROBLEM: By-pass valve not functioning.*
   SOLUTION: Check and repair.

E. FAILURE OF JAWS TO GRIP PIPE

1. *POSSIBLE PROBLEM: Dies have become too dull to provide adequate grip.*
   SOLUTION: Replace dies.

2. *POSSIBLE PROBLEM: Incorrect jaws are being used.*
   SOLUTION: Double-check jaw size to ensure they are rated for the diameter of pipe or casing being run.

3. *POSSIBLE PROBLEM: Incorrect dies are being used*
   SOLUTION: Ensure dies loaded in the jaws are appropriate for the type of pipe or casing being run.

4. *POSSIBLE PROBLEM: Brake band(s) is (are) insufficiently adjusted, not allowing jaws to cam properly.*
   SOLUTION: Adjust brake bands to give proper resistance to cage plates.

5. *POSSIBLE PROBLEM: Jaw roller broken or worn.*
   SOLUTION: Remove jaw assembly and inspect. Replace rollers that are visibly "flat-spotted" or otherwise damaged.

F. FAILURE OR DIFFICULTY OF TONG TO SHIFT

1. *POSSIBLE PROBLEM: Bent or broken shifter handle.*
   SOLUTION: Replace shifter handle.

2. *POSSIBLE PROBLEM: Bent or broken shifter yoke.*
   SOLUTION: Inspect and replace shifter yoke.

3. *POSSIBLE PROBLEM: "Frozen" or hard-to-move shifter handle.*
   SOLUTION: Grease shifter shaft.

4. *POSSIBLE PROBLEM: Bent or broken shifter shaft.*
   SOLUTION: Replace.

5. *POSSIBLE PROBLEM: Locking nuts on shifting shaft have loosened and position of yoke has changed.*
   SOLUTION: Reposition yoke and re-tighten locking nuts.

6. *POSSIBLE PROBLEM: Shifting yoke has come loose from shifting shaft*
   SOLUTION: Inspect yoke and inspect for damage. If free of damage, replace on shaft and tighten locking nuts.

7. *POSSIBLE PROBLEM: Tong pops out of gear*
   SOLUTION: Ensure that detent ball & spring assembly has been correctly set.

G. GENERAL COMMENTS

The following factors generally contribute to poor hydraulic operation and premature wear of equipment:

1. *Contaminated hydraulic fluid due to overuse, overheating, or inadequate fluid filtration.*
2. *Unsuitable hydraulic fluid, especially in extreme climatic conditions.*
3. *Defective packing or seals in components of the hydraulic system.*
4. *Poor or incomplete hydraulic system training. Users must be fully qualified to operate the equipment, and have complete understanding of the hydraulic system.*

If your hydraulic troubleshooting procedures involve flow and pressure tests at the power unit, Farr Canada Corp. recommends construction of a test rig that can easily be connected to the main suction and discharge ports of the power unit.

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PARTS AND ASSEMBLIES

MODEL 80-0609-7 SHOWN

MODEL 80-0609-7-CE SHOWN

The following table lists parts that McCoy Drilling & Completions | FARR has identified as critical spare parts for this model of tong. McCoy recommends that the specified quantity of each part be on hand at all times.

MISC TONG & BACKUP PARTS		
Description	**Part Number**	**Qty. Required**
Dumbbell Roller	1037-135	2
Motor Gear	997-A10-149	1
Door Latch Spring	997-16	2
Jaw Pivot Bolt	1050-C5-28	2
Shifting Collar	997-A9-62	1
Cage Plate Spacer	1050-C3-38	3
Rigid Sling Pins	1053-C-1C	2
BEARINGS & BUSHINGS		
Description	**Part Number**	**Qty. Required**
Dumbbell Roller Bearing	02-0094	10
Rotary Idler Bearing	02-0011	2
Pinion Bearing	02-0007	2
Ball Bearing (Bottom Clutch Bearing)	02-0004	1
Needle Bearing (Clutch Shaft)	02-0003	4
Ball Bearing (Top Clutch Bearing)	02-0002	1
Cam Follower	02-0015	5
FASTENERS & FITTINGS		
Description	**Part Number**	**Qty. Required**
Idler Bearing Seal	02-0010	4
Idler Gear Retainer	02-0009	4
External Snap Ring Clutch	02-0001	2
Motor Gear Set Screw	09-0106	1
Motor Gear Key	01-0317	1
Hex Bolt 1/2" UNC X 7" (Cage Plate Bolt)	09-1194	2
Hex Bolt 1/2" UNC X 9" (Backing Pin Bolt)	09-1202	1
5/8" Lock Washer (Cam Follower Fastener)	09-5114	5
5/8" UNF Jam Nut (Cam Follower Fastener)	09-5514	5
HYDRAULIC COMPONENTS		
Description	**Part Number**	**Qty. Required**
Relief Valve (Backup)	08-1180	1
Check Valve (Backup)	08-0481	1
Relief Cartridge (DVA35)	10-0010R	1
Relief Cartridge (Safety Door)	08-1625	1
Seal Kit - Rineer GA15	87-7110	1
DVA35 Seal Kit	07-0004	1
Safety Door Switch	08-0337M	1
Hydraulic Hose - Lift Cylinder Supply	02-0934H	1
High-Visibility Protective Wrap, Lift Cylinder Hydraulic Hose	02-E0203	1

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Critical Spare Parts List (Continued)		
JAW COMPONENTS		
Description	**Part Number**	**Qty. Required**
Jaw Roller	1050-JR-2125	2
Jaw Pin	1050-JP	2
3.875" Flat Die Insert	13-0008-314-0	48
Contoured Insert (2-3/8" jaw die kits only)	12-0004	8
Contoured Insert (2-7/8" jaw die kits only)	12-0007	8
Contoured Insert (3-1/8" to 3-1/2" jaw die kits only)	12-0011	16

ITEMS ON THE CRITICAL SPARE PARTS LIST MARKED IN RED INDICATE ESSENTIAL HEALTH & SAFETY ITEMS. FAILURE TO REPLACE DAMAGED ESSENTIAL HEALTH & SAFETY ITEMS WILL PRESENT IMMEDIATE DANGER TO PERSONNEL OR EQUIPMENT. HAVE THESE ITEMS ON HAND AT ALL TIMES. STOP WORK AND QUARANTINE TONG UPON DISCOVERY OF DAMAGED OR DEFECTIVE HEALTH AND SAFETY COMPONENTS UNTIL PARTS CAN BE REPLACED.

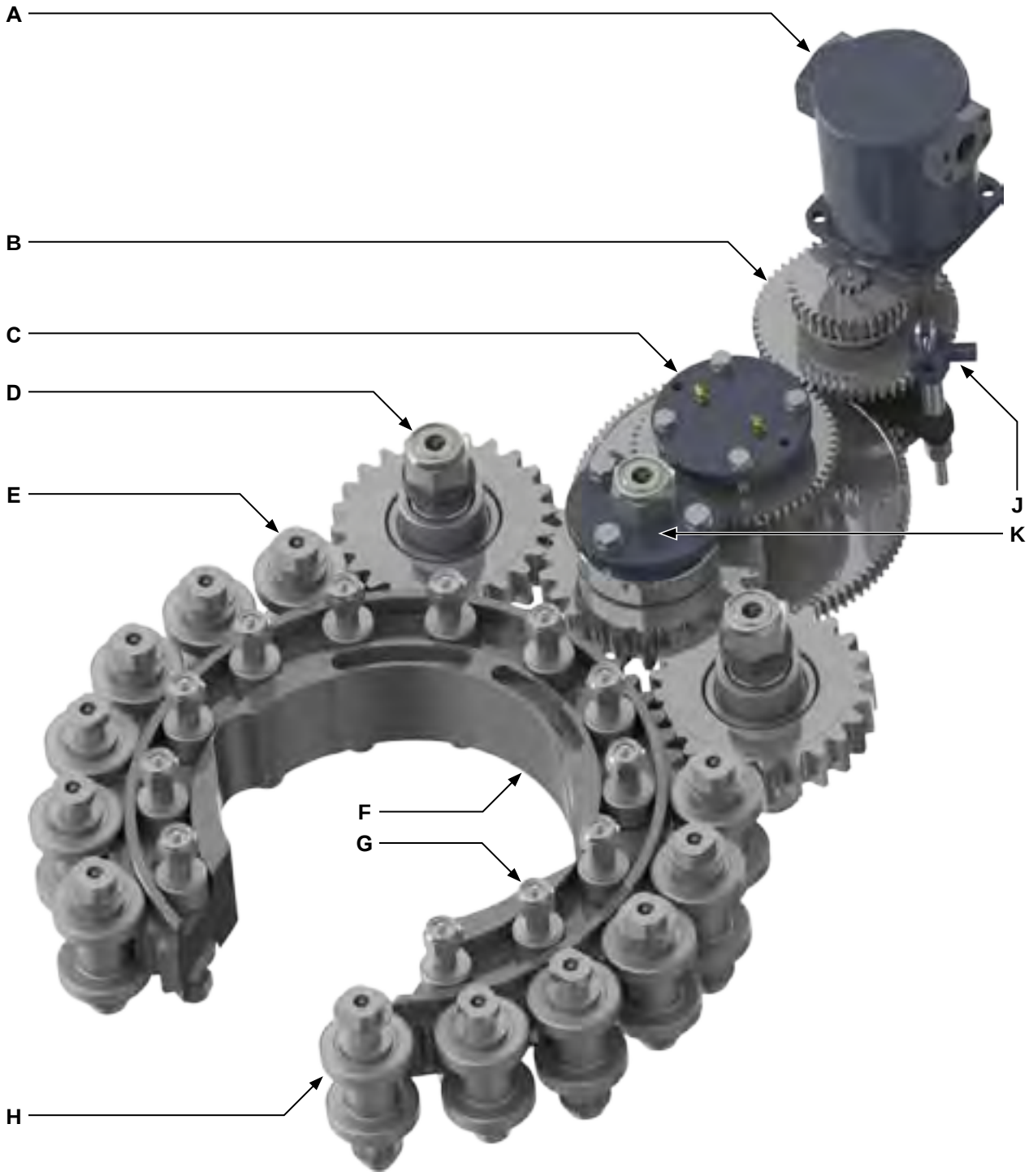
In addition to the critical spare parts identified in the previous table, McCoy suggests stocking the following spare parts. Even though these are not critical spares, stocking these components may significantly decrease repair time in the event of long lead times from the factory.

MISC TONG PARTS		
Description	**Part Number**	**Qty. Recommended**
Backing Pin	101-4188	1
Backing Pin Spacer	101-4096	1
Backing Pin Stud	101-4097	1
Backing Pin Knob	02-0017	1
Shifting Yoke Weldment	1050-72-1	1
Shifting Shaft	1116-71	1
Door Spring Cylinder	101-0069	1
Brake Band Retainer	101-0140	2
Lined Brake Band Weldment	1050-D4-29	2
Safety Door Load Plunger	AE12-306	1
BEARINGS & BUSHINGS		
Description	**Part Number**	**Qty. Recommended**
Door Bushing	101-0110	2
FASTENERS & FITTINGS		
Description	**Part Number**	**Qty. Recommended**
Shifter Detent Force Spring	997-0-64	1
Shifter Detent Force Ball	02-0018	1
1/8" NPT Grease Fitting	02-0005	2
1/8" NPT 90° Grease Fitting	02-0093	2
1/8" NPT 45° Grease Fittings	02-0006	2
1/4" Straight Thread Grease Fitting	02-0097	5
3/8 UNC X .5" Flange Bolt (Jaw Retainer)	09-0229	10
5/16 UNC X .5" Countersunk (Jaw Retainer)	09-1338	10

MISC TONG PARTS		
Description	**Part Number**	**Qty. Required**
Jaw Pivot Bolt	1050-C5-28	2
Backing Pin	101-4188	1
Backing Pin Spacer	101-4096	1
Backing Pin Stud	101-4097	1
Backing Pin Knob	02-0017	1
Backing Pin Retainer	101-4186	1
Backing Pin Spacer	101-4187	1
Cage Plate Spacer	1050-C3-38	3
Lined Brake Band Weldment	1050-D4-29	2
Brake Band Retainers	101-0140	2
Door Cylinder	101-0069	1
Door Cylinder Post	1050-12-001	1
Latch Springs	997-16	2
Safety Door Interlock	101-1103	1
Safety Door Interlock	101-1104	1
Safety Door Load Plunger	AE12-306	1
Shifting Shaft	1116-71	1
Shifting Yoke	1050-72-1	1
Top Shifter Bushing	101-0020	1
Dumbbell Roller	1037-135	12
Roller Spacer	101-3871	24
Roller Spacer	1037-C-134	12
Door Pivot Roller Shaft	101-3940	1
Roller Shaft	101-3939	11
Drive Gear (Clutch)	997-A3-61	1
Shifting Collar	997-A9-62	1
High Clutch Gear	997-A1-51	1
Splined Clutch Shaft	997-A8-50	1
Low Clutch Gear	997-A1-52	1
Motor Gear	997-A10-149	1
BEARINGS & BUSHINGS		
Description	**Part Number**	**Qty. Required**
Dumbbell Roller Bearings	02-0094	24
Idler Bearing	02-0011	3
Pinion Bearing	02-0007	2
Ball Bearing (Bottom Clutch Bearing)	02-0004	1
Needle Bearing (Clutch Shaft)	02-0003	4
Ball Bearing (Top Clutch Bearing)	02-0002	1
Cam Follower	02-0015	26
Door Bushing	101-0110	2

FASTENERS & FITTINGS		
Description	**Part Number**	**Qty. Required**
Rotary Idler Seal	02-0010	5
Rotary Idler Retainer	02-0009	6
1/4" Straight Thread Grease Fitting	02-0097	12
1/8" NPT Grease Fitting	02-0005	4
1/8" NPT 90° Grease Fitting	02-0093	7
1/8" NPT 45° Grease Fittings	02-0006	1
Snap Ring (Clutch Shaft)	02-0001	1
Motor Gear Set Screw	09-0106	2
Motor Key	01-0317	1
1-1/8" Narrow Flat Washer (Support Roller Top Washer)	02-0471	8
1" Narrow Flat Washer (Support Roller Bottom Washer)	09-5120	6
1" UNS Thin Nylock Nut	09-9167	12
Hex Bolt 1/2" UNC X 7" (Cage Plate Bolt)	09-1194	2
Hex Bolt 1/2" UNC X 9" (Backing Pin Bolt)	09-1202	1
5/8" Lock Washer (Cam Follower Fastener)	09-5114	26
5/8" UNF Jam Nut (Cam Follower Fastener)	09-5514	26
Shifter Detent Force Spring	997-0-64	1
Shifter Detent Force Ball	02-0018	1
HYDRAULIC COMPONENTS		
Description	**Part Number**	**Qty. Required**
Safety Door Switch	08-0337M	1
Rineer GA15 Seal Kit	87-7110	1
DVA35 Seal Kit	07-0004	1
Relief Cartridge (DVA35)	10-0010R	1
Relief Cartridge (Safety Door)	08-1625	2
Hydraulic Hose - Lift Cylinder Supply	02-0934H	1
High-Visibility Protective Wrap, Lift Cylinder Hydraulic Hose	02-E0203	1

ITEMS ON THE CRITICAL SPARE PARTS LIST MARKED IN RED INDICATE ESSENTIAL HEALTH & SAFETY ITEMS. FAILURE TO REPLACE DAMAGED ESSENTIAL HEALTH & SAFETY ITEMS WILL PRESENT IMMEDIATE DANGER TO PERSONNEL OR EQUIPMENT. HAVE THESE ITEMS ON HAND AT ALL TIMES. STOP WORK AND QUARANTINE TONG UPON DISCOVERY OF DAMAGED OR DEFECTIVE HEALTH AND SAFETY COMPONENTS UNTIL PARTS CAN BE REPLACED.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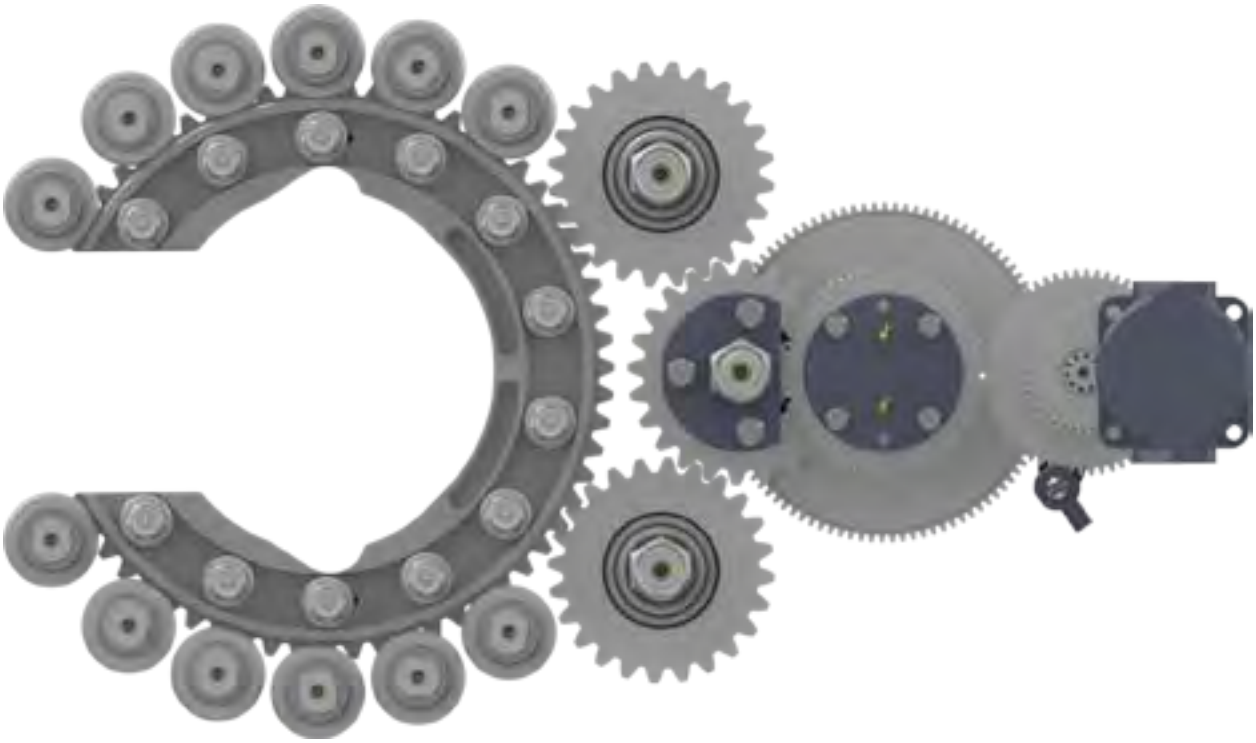
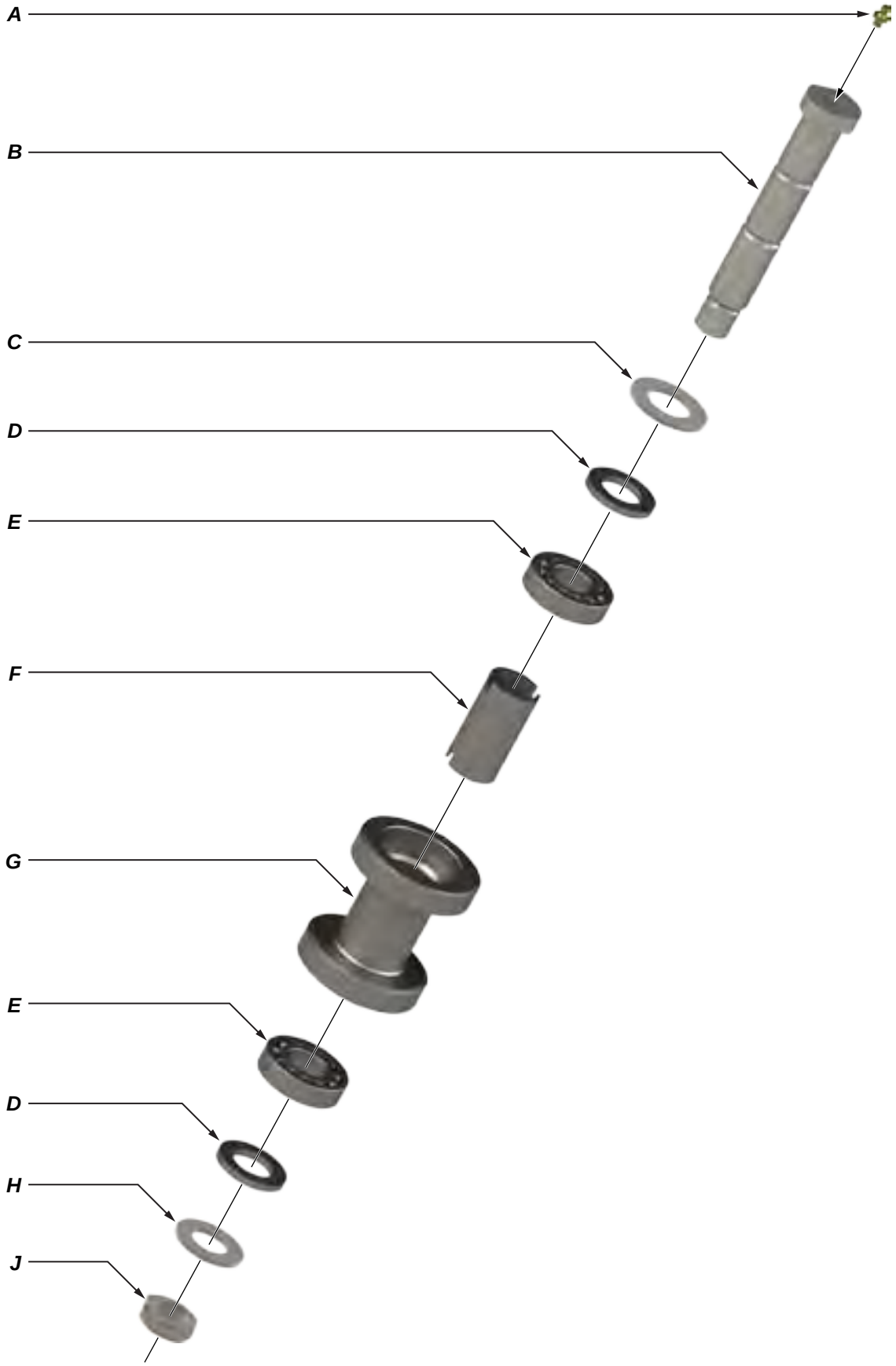
ITEM	TYPE	DESCRIPTION	QTY	PART NUMBER
A	Part	Hydraulic Motor	1	87-0112
B	Assembly	Clutch Assembly (See Pp. 5.14 - 5.15)	1	
C	Assembly	Pinion Assembly (See Pp. 5.12 - 5.13)	1	
D	Assembly	Rotary Idler Assembly (See Pp. 5.8 - 5.9)	2	
E	Assembly	Support Roller Assembly (See Pp. 5.4 - 5.5)	11	
F	Part	Rotary Gear	1	1172-D1
G	Assembly	Cam Follower Assembly (See Pp. 5.18 - 5.19)	24	
H	Assembly	Door Pivot Roller Assembly (See Pp. 5.6 - 5.7)	1	
J	Assembly	Shifter Assembly (See Pp. 5.16 - 5.17)	1	
K	Assembly	Pinion Idler Assembly (See Pp. 5.10 - 5.11)	1	
L	Part	Motor Gear	1	997-A10-149

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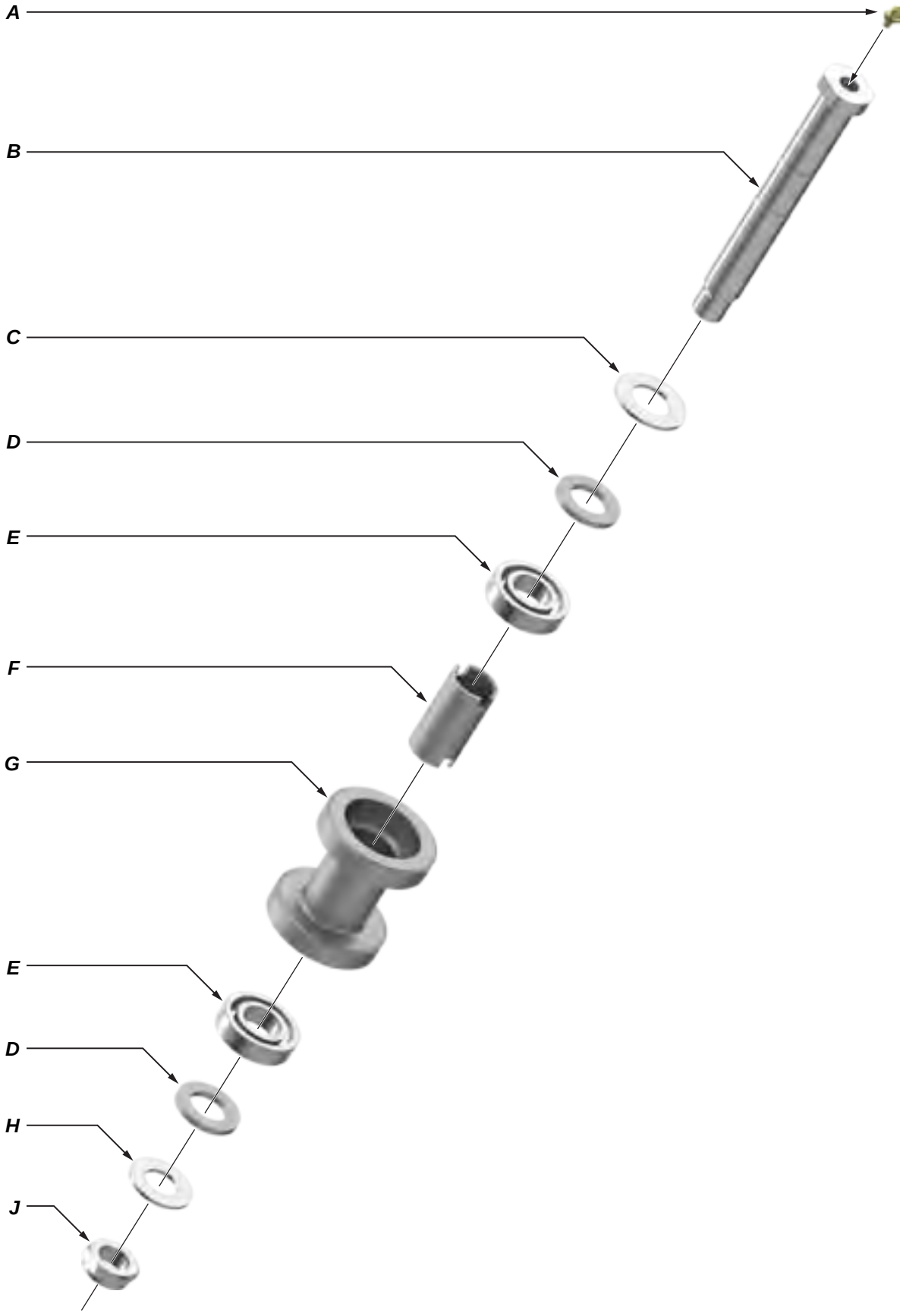
Item	Type	Description	Qty	Part Number
A	Part	1/4" Straight Thread Grease Fitting	1	02-0097
B	Part	Support Roller Shaft	1	101-3939
C	Part	1-1/8" Narrow Flat Washer (1)	1	02-0471
D	Part	Support Roller Spacer	2	101-3871
E	Part	Bearing	2	02-0094
F	Part	Support Roller Internal Spacer	1	1037-C-134
G	Part	Support Roller	1	1037-135
H	Part	1" Narrow Washer (1)	1	09-5120
J	Part	1" UNS Thin Nylock Nut	1	09-9167

(1) Where support rollers are coincidental with brake band lug weldments upper and lower washers are not used. Where support rollers are coincidental with front leg weldments lower washers are not used.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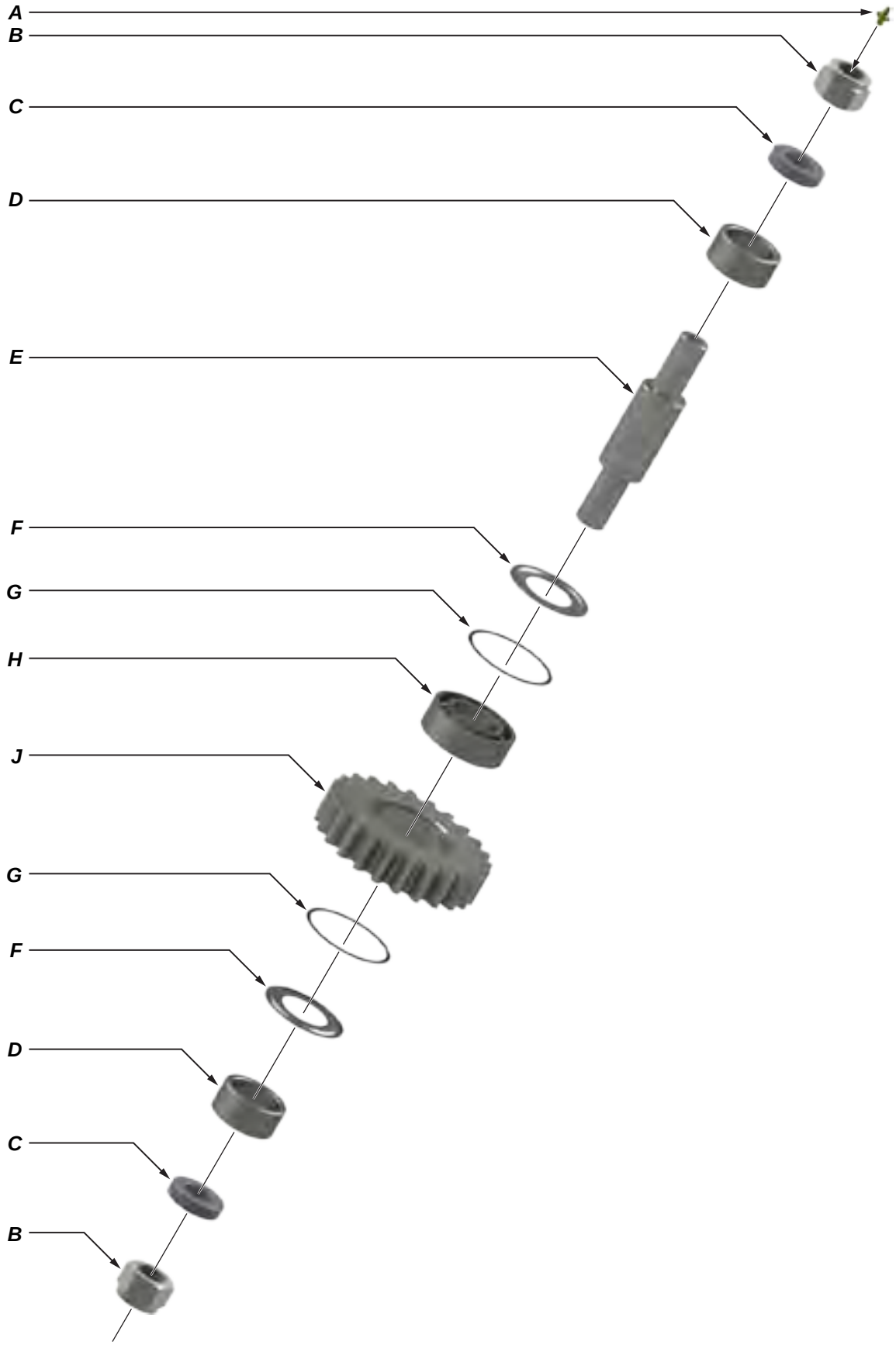
Item	Type	Description	Qty	Part Number
A	Part	1/4" Straight Thread Grease Fitting	1	02-0097
B	Part	Door Pivot Roller Shaft	1	101-3940
C	Part	1-1/8" Narrow Flat Washer	1	02-0471
D	Part	Support Roller Spacer	2	101-3871
E	Part	Bearing	2	02-0094
F	Part	Support Roller Internal Spacer	1	1037-C-134
G	Part	Support Roller	1	1037-135
H	Part	1" Narrow Washer	1	09-5120
J	Part	1" UNS Thin Nylock Nut	1	09-9167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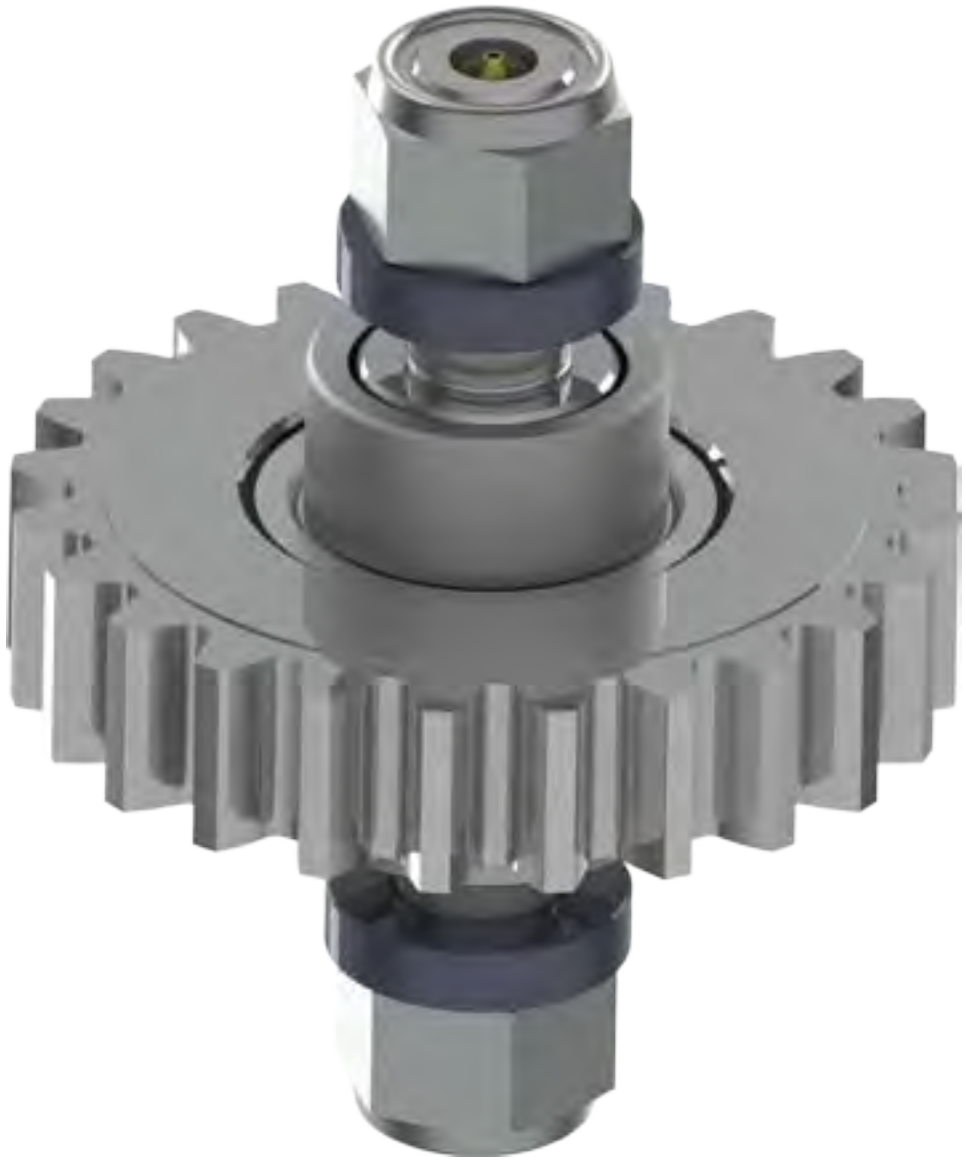
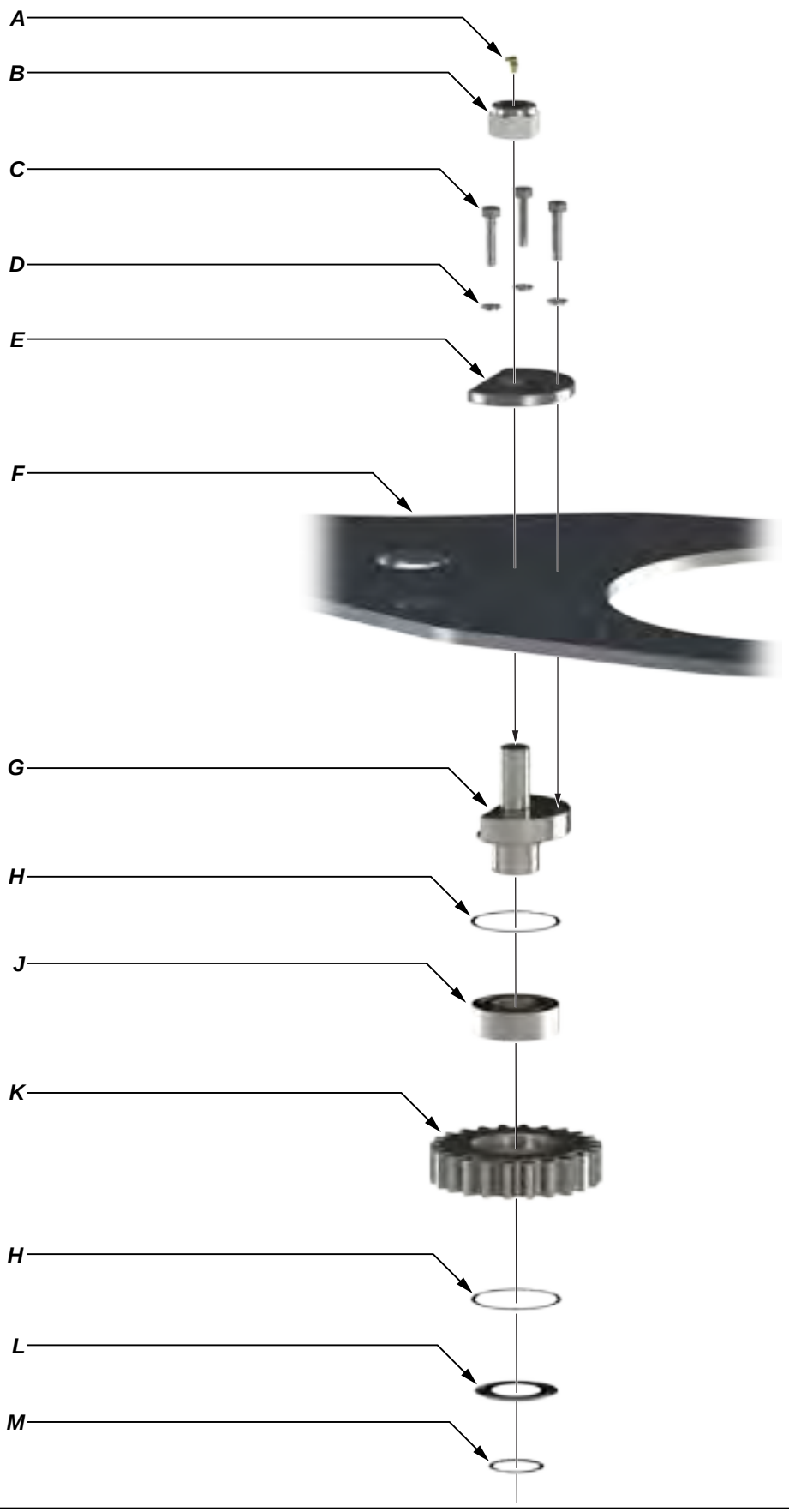


Item	Type	Description	Qty	Part Number
A	Part	1/8" NPT Grease Fitting	1	02-0005
B	Part	1-1/4" UNF Hex Nylock Nut	2	09-5740
C	Part	Idler Pad	2	997-D20-125
D	Part	Rotary Idler Spacer	2	1050-D5-121
E	Part	Rotary Idler Shaft	1	1050-D5-117
F	Part	Bearing Seal	2	02-0010
G	Part	Retaining Ring	2	02-0009
H	Part	Bearing	1	02-0011
J	Part	Rotary Idler Gear	1	997-A2-119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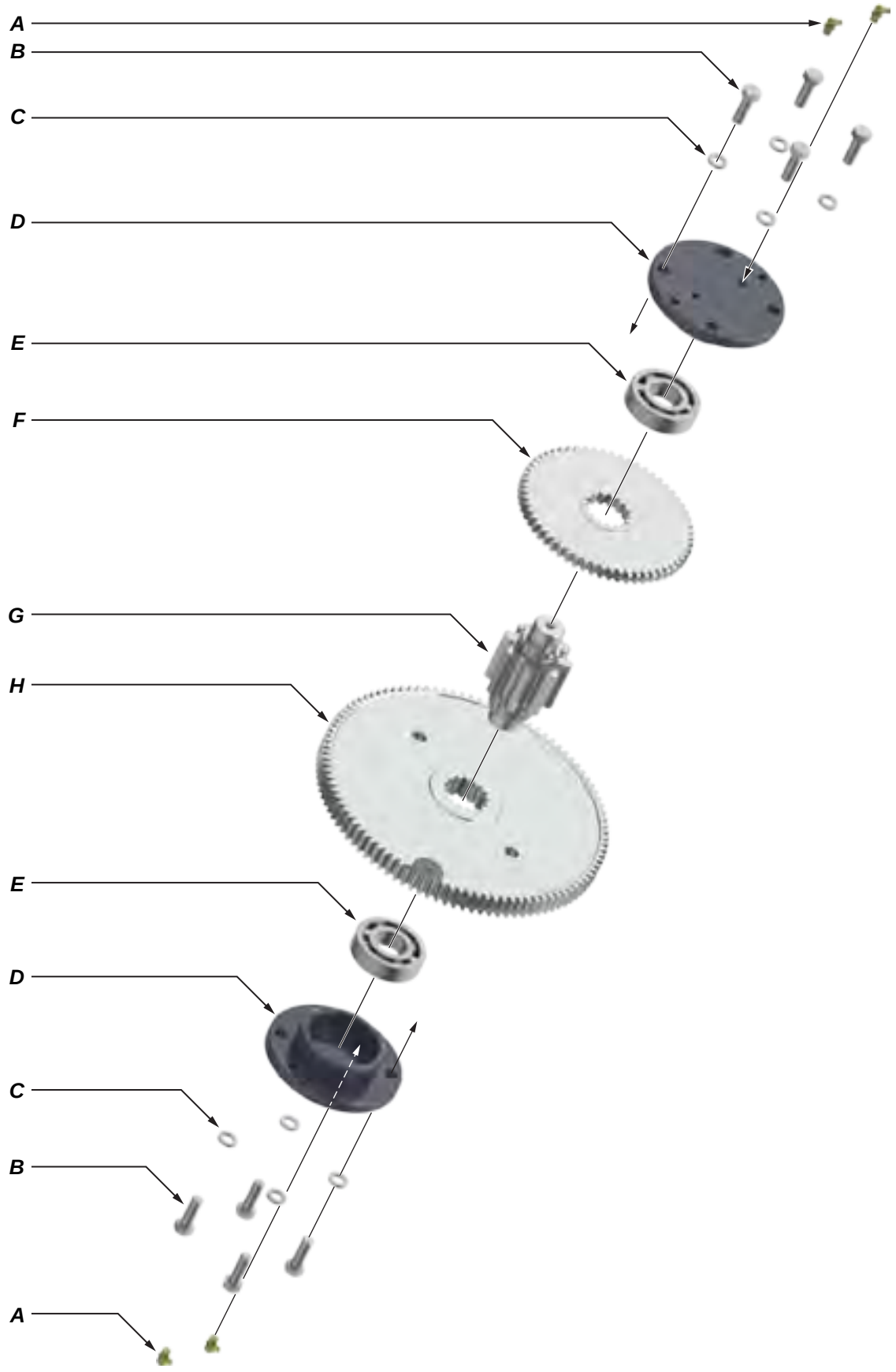
Item	Type	Description	Qty	Part Number
A	Part	90° 1/8" NPT Grease Fitting	1	02-0093
B	Part	1-1/2" UNF Hex Nylock Nut	1	09-5740
C	Part	5/8" UNC x 2-1/2" Hex Bolt	3	09-0081
D	Part	5/8" Lock Washer	3	09-5114
E	Part	Idler Pad	1	997-D17-109
F	Part	Top Plate (Shown for illustration purposes only)	1	
G	Part	Pinion Idler Half Shaft	1	1050-D5-105
H	Part	Retaining Ring	2	02-0009
J	Part	Bearing	1	02-0011
K	Part	Pinion Idler Gear	1	997-A2-119
L	Part	Bearing Seal	1	02-0010
M	Part	Bearing Retainer	1	02-0008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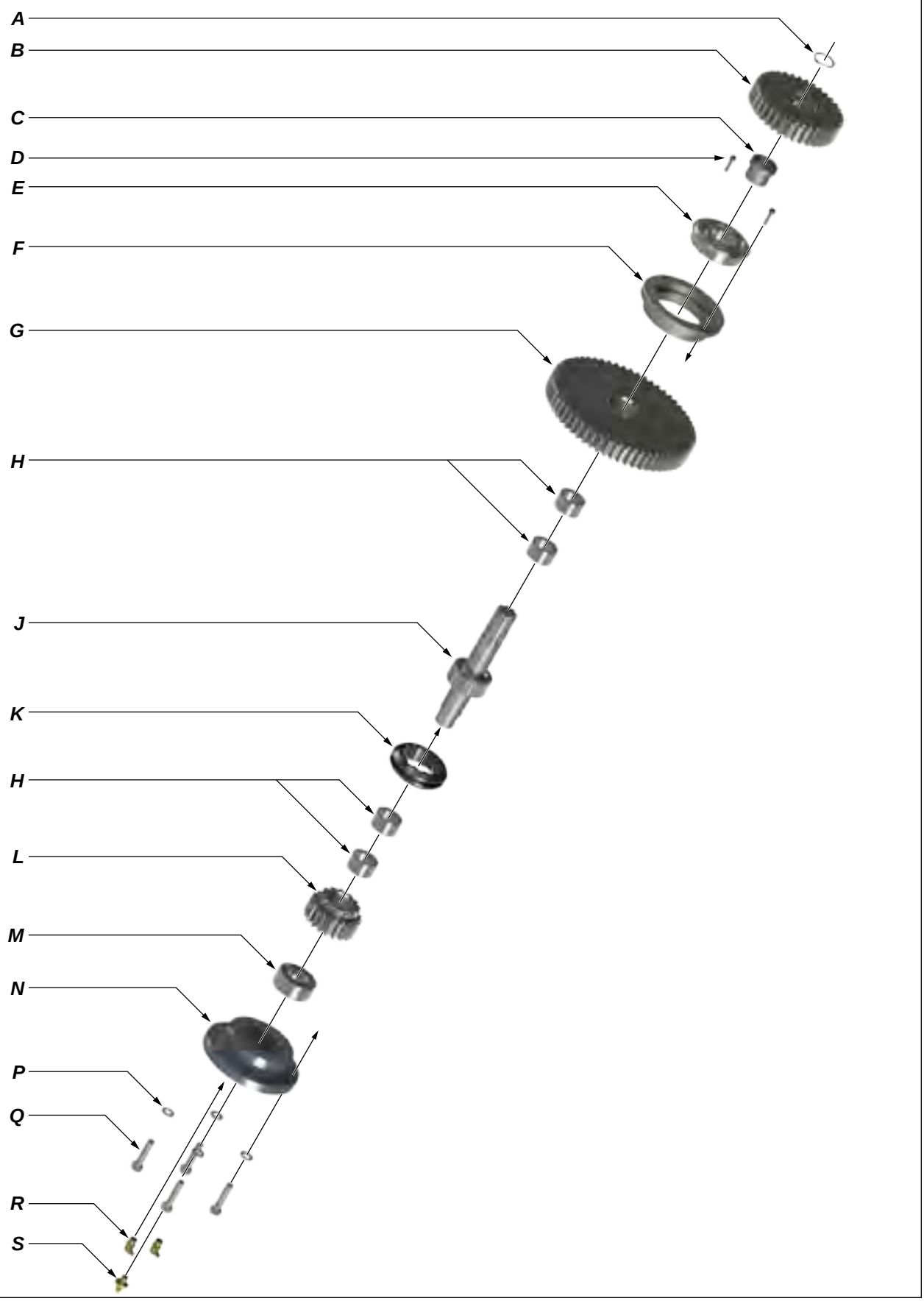
Item	Type	Description	Qty	Part Number
A	Part	1/8" NPT 90° Grease Fitting	4	02-0093
B	Part	1/2" UNC x 1-1/2" Hex Bolts	8	09-1170
C	Part	1/2" Lock Washers	8	09-5110
D	Part	Pinion Bearing Cap	2	1050-89
E	Part	Pinion Bearing	2	02-0007
F	Part	High Pinion Gear	1	997-A4-87
G	Part	Pinion Gear Shaft	1	997-A7-86
H	Part	Low Pinion Gear	1	997-A5-88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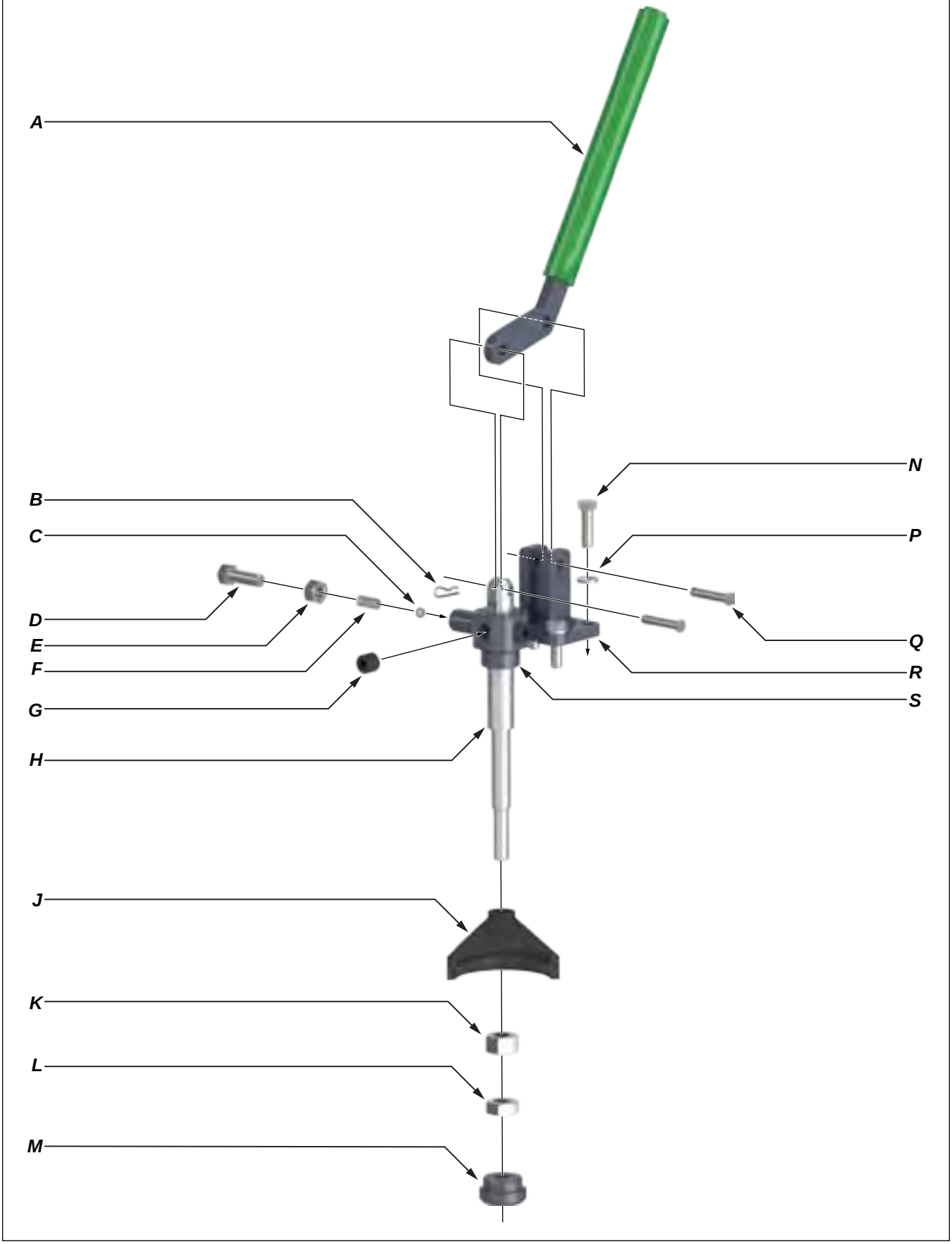
Item	Type	Description	Qty	Part Number
A	Part	Outside Snap Ring	1	1234-00-04
B	Part	Drive Gear	1	997-A3-61
C	Part	Top Clutch Bearing Spacer	1	997-60
D	Part	#10-24 x 3/4" Hex SHCS	2	09-0001
E	Part	Top Clutch Bearing	1	02-0002
F	Part	Top Bearing Retainer	1	997-D11-59
G	Part	High Clutch Gear	1	997-A1-51
H	Part	Needle Roller Bearing	4	02-0003
J	Part	Splined Clutch Shaft	1	997-A8-50
K	Part	Shifting Collar	1	997-A9-62
L	Part	Low Clutch Gear	1	997-A1-52
M	Part	Bottom Clutch Bearing	1	02-0004
N	Part	Clutch Bearing Cap	1	1050-C1-54
P	Part	3/8" Lock Washer	4	09-5106
Q	Part	3/8" UNC x 1-1/4" Hex Bolt	4	09-1048
R	Part	1/8" NPT Grease Fitting	1	02-0005
S	Part	1/8" NPT 90 Deg. Grease Fitting	2	02-0093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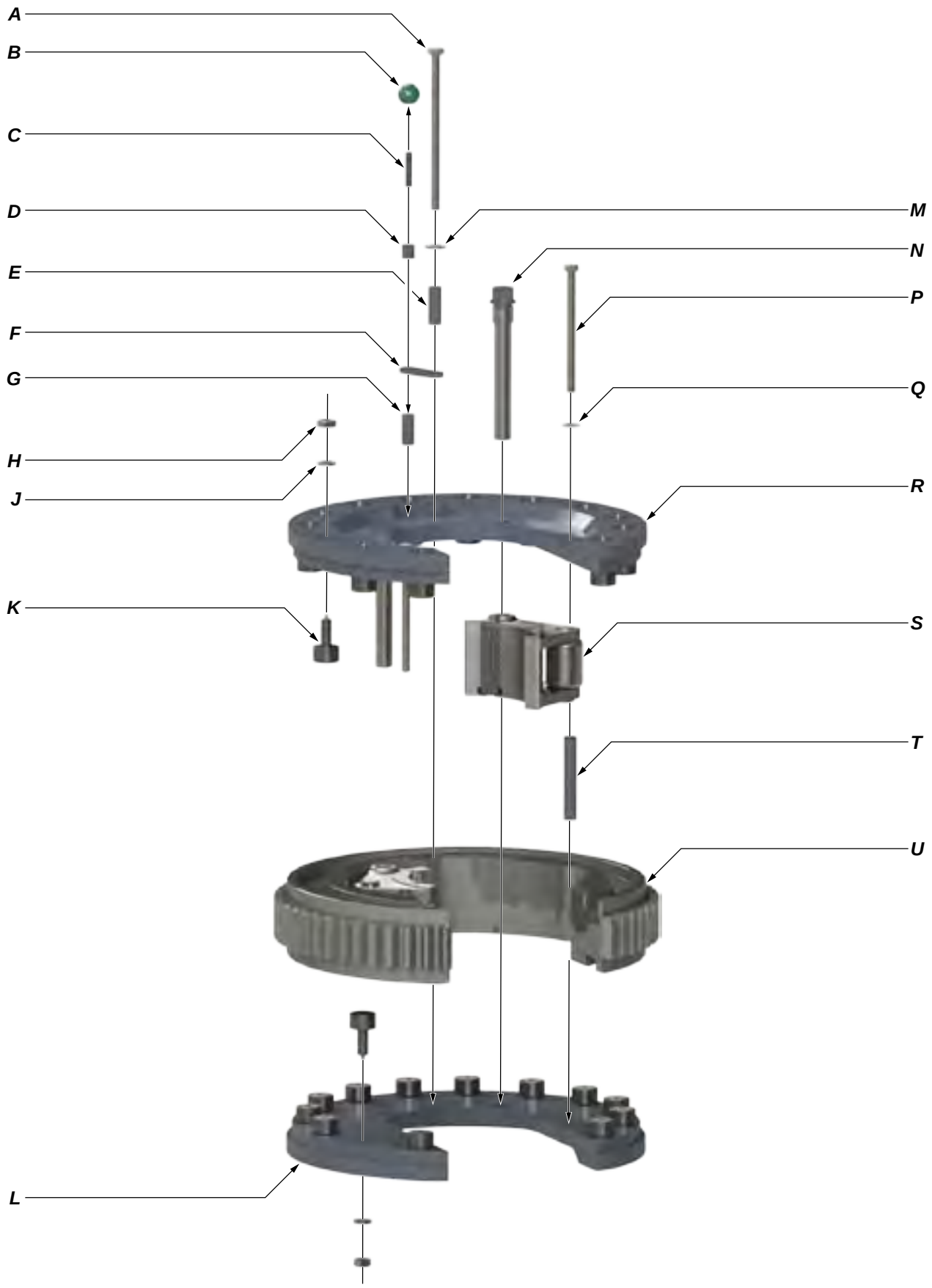
Item	Type	Description	Qty	Part Number
A	Weldment	Shifting Handle Weldment	1	1037-D-20B
B	Part	HITCH PIN .0930 X 1.125	2	02-0274
C	Part	Detent Ball	1	02-0018
D	Part	7/16" UNF x 1-1/4" Hex Bolt	1	09-1608
E	Part	7/16" UNF Hex Jam Nut	1	09-5508
F	Part	Detent Spring	1	997-0-64
G	Part	5/8" UNC x 5/8" Hex Socket Set Screw	3	09-2011
H	Part	Shifting Shaft	1	1116-71
J	Weldment	Shifting Fork Weldment	1	1050-72
K	Part	5/8" UNF Hex Nut	1	09-5914
L	Part	5/8" UNF Hex Jam Nut	1	09-5915
M	Part	Lower Shifter Bushing (typically welded to bottom plate)	1	1064-B1-95
N	Part	3/8" UNC x 1" Hex Bolt	4	09-1046
P	Part	3/8" Lock Washer	4	09-5106
Q	Part	5/16" x 1-1/2" Clevis Pin	2	09-0256
R	Part	Shifter Lug Weldment (Bolted)	1	101-0016
S	Part	Top Shifter Bushing (threaded)	1	101-0020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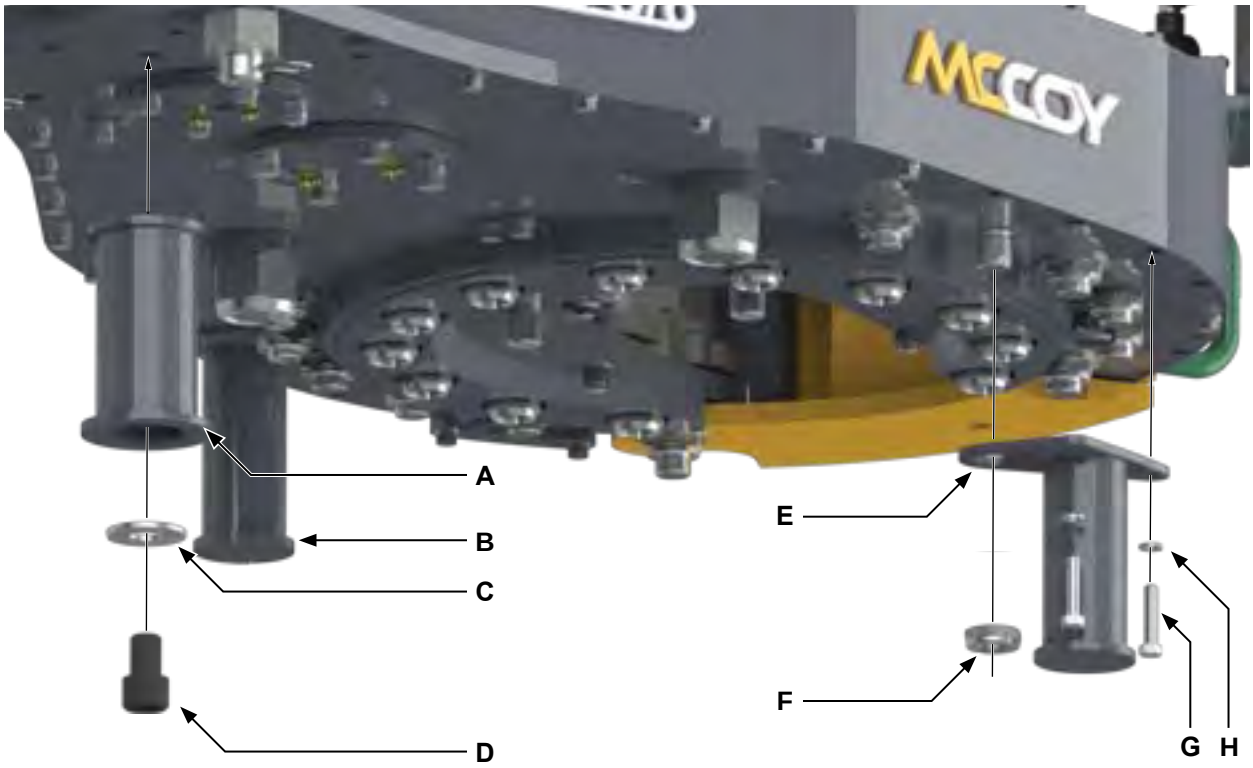
Item	Type	Description	Qty	Part Number
A	Part	1/2" UNC x 9" Hex Bolt	1	09-1202
B	Part	Backing Pin Knob	1	02-0017
C	Part	3/8" UNF x 2" Threaded Stud	1	101-4097
D	Part	Backing Pin Spacer	1	101-4096
E	Part	Backing Pin Spacer	1	101-4186
F	Part	Backing Pin Retainer	1	101-4187
G	Part	Backing Pin	1	101-4188
H	Part	5/8" UNF Hex Jam Nut	26	09-5514
J	Part	5/8" Lock Washer	26	09-5114
K	Part	Cam Follower	26	02-0015
L	Part	Cage Plate - BOTTOM	1	1050-22
M	Part	1/2" Regular Flat Washer	1	09-5010
N	Part	Jaw Pivot Bolt	2	1050-C5-28
P	Part	1/2" UNC x 7" Hex Bolt	2	09-1194
Q	Part	1/2" Narrow Flat Washer	1	09-5119
R	Part	Cage Plate - TOP	1	1050-21
S	Assembly	Jaw Die Kit (5-1/2" shown - see Pp. 2.10 - 2.11)	2	
T	Part	Cage Plate Spacer	3	1050-C3-38
U	Part	Rotary Gear	1	1172-D1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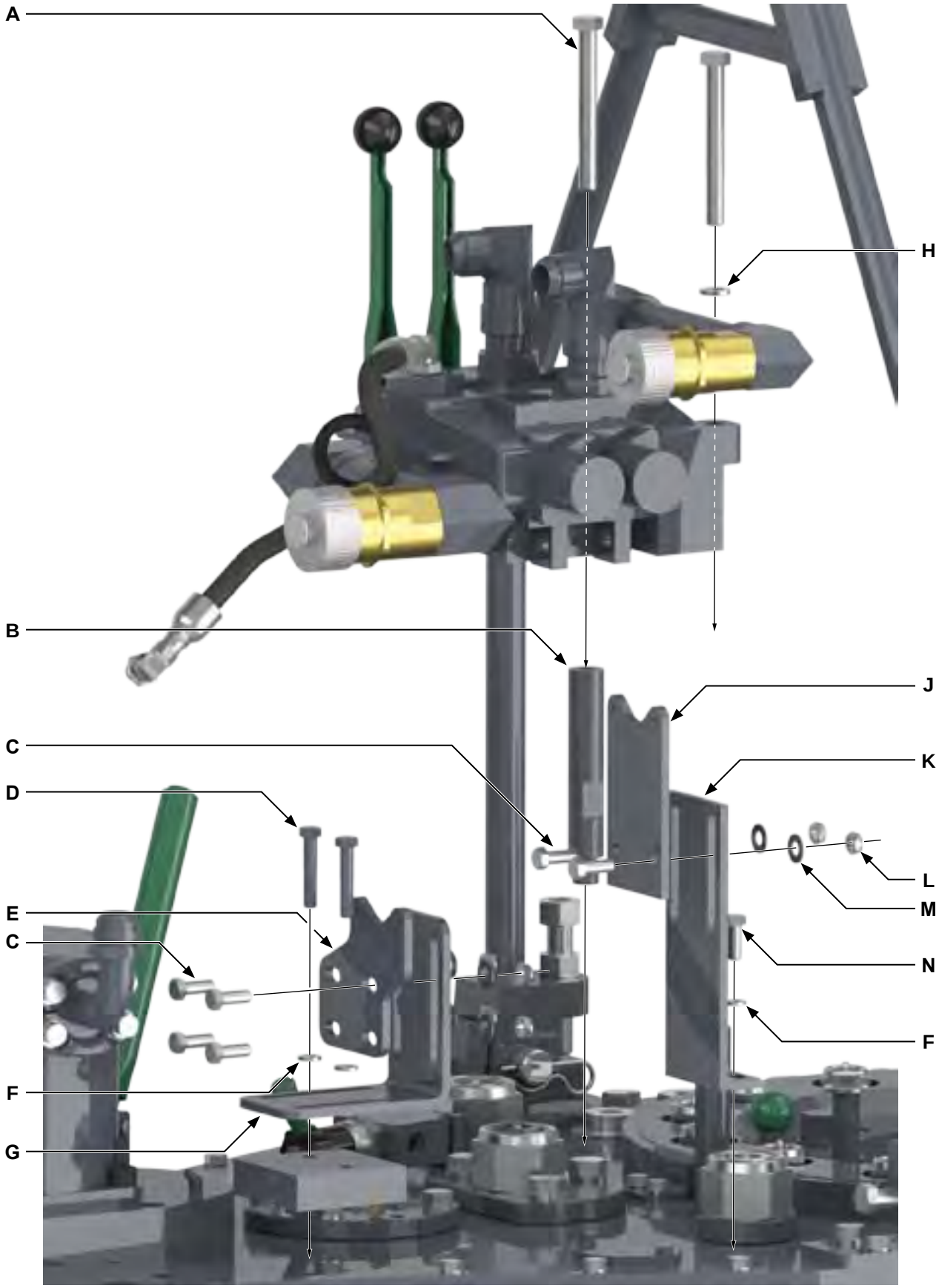
Item	Type	Description	Qty	Part Number
A	Weldment	Rear Leg Weldment	1	997-D8-160A
B	Weldment	LH Leg Weldment	1	101-0162
C	Part	Regular 7/8" Flat Washer	1	09-5022
D	Part	7/8" UNC x 1-1/4" Hex Socket Head Cap Screw		
E	Weldment	RH Leg Weldment	1	101-0163
F	Part	1" UNS Thin Nylock Nut	1	09-9167
G	Part	3/8" NC x 2" Hex Bolt	4	09-1054
H	Part	3/8" Carbon Steel Lock Washer	4	09-5106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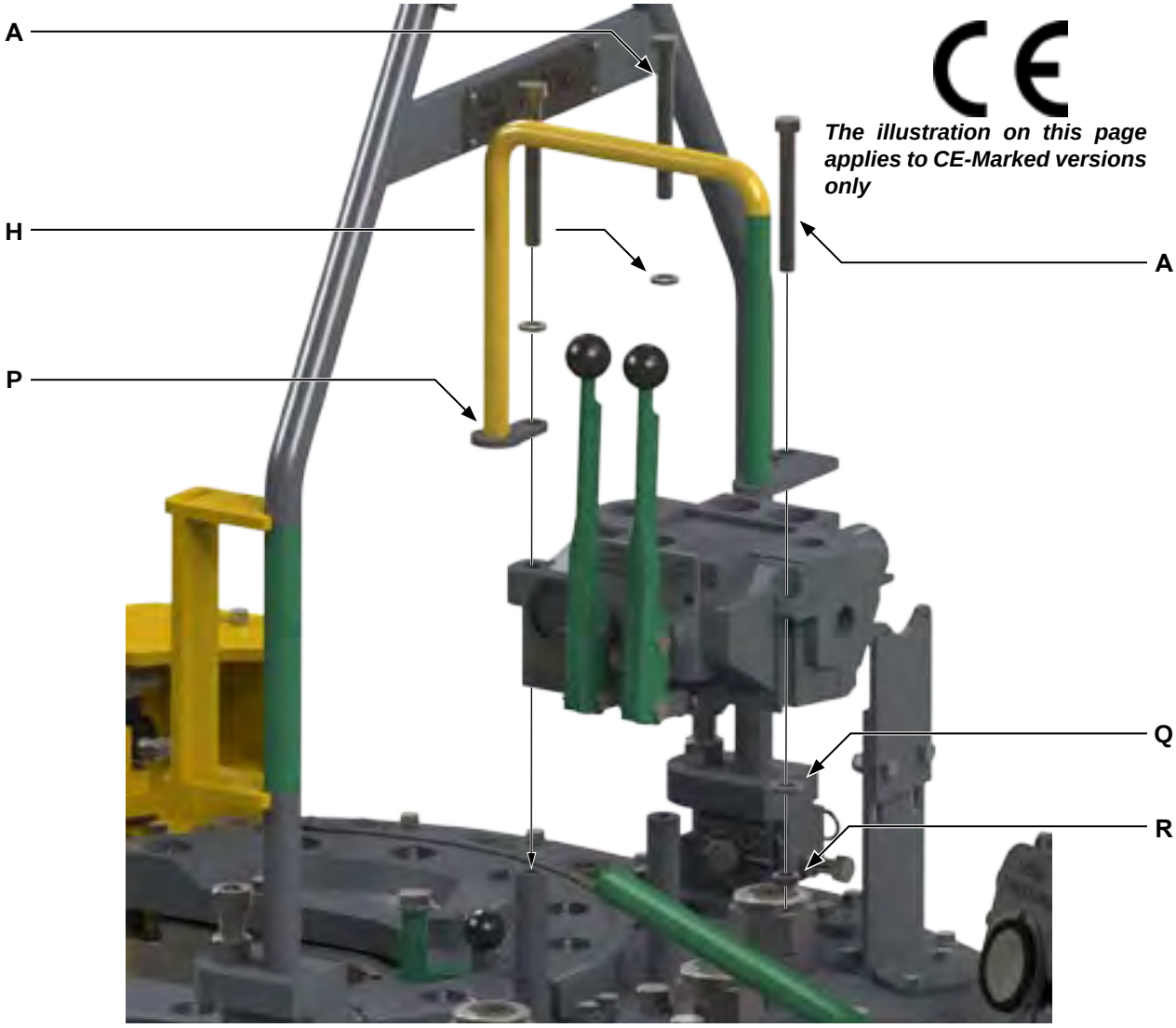
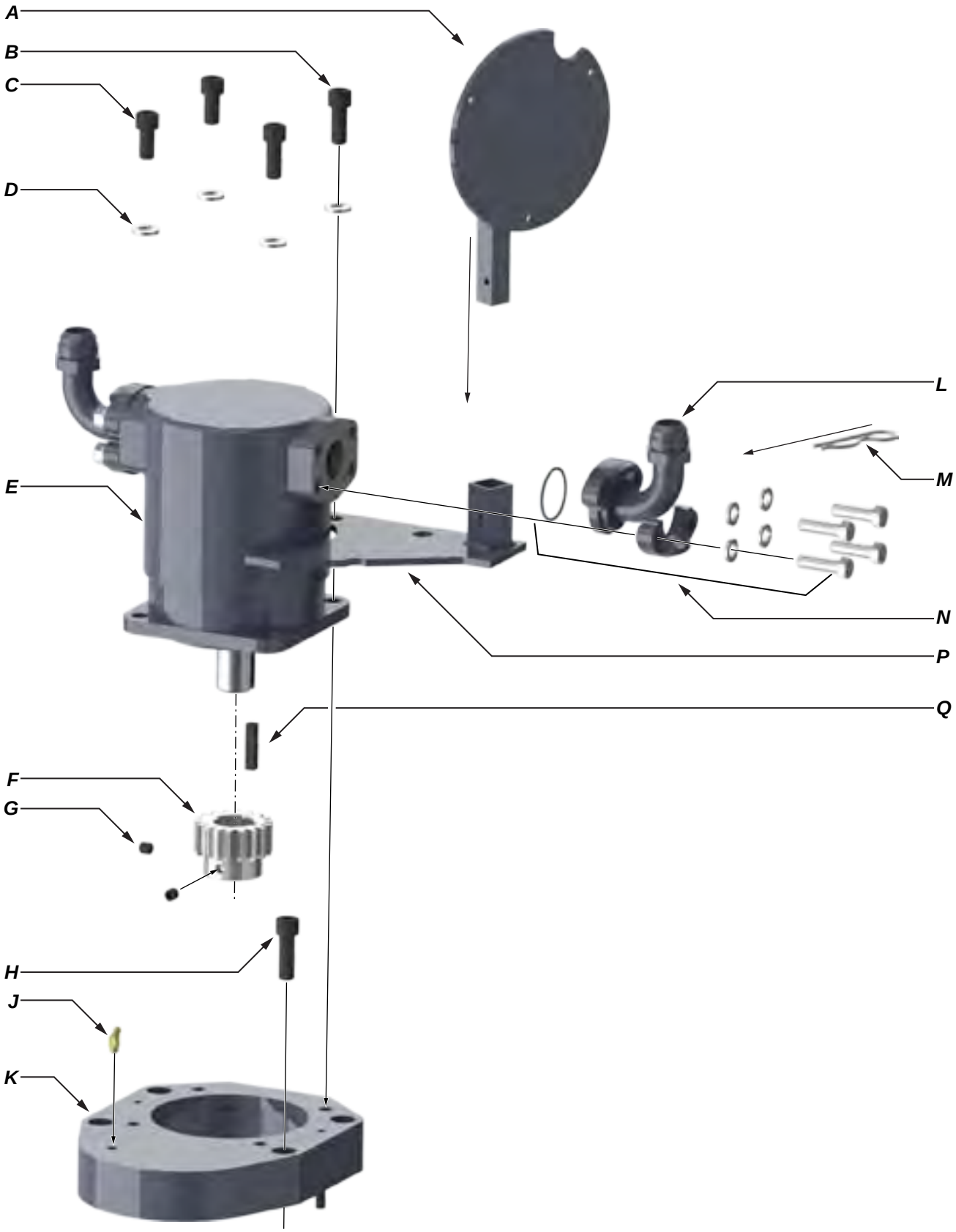


CE

The illustration on this page applies to CE-Marked versions only

Item	Type	Description	Qty	Part Number
A	Part	1/2" UNC x 4-1/2" Hex Bolt	3	09-1184
B	Part	Hydraulic Valve Mount Post	2	101-0116
C	Part	3/8" UNC x 1" Hex Bolt	6	09-1046
D	Part	3/8" UNC x 2" Hex Bolt	2	09-1054
E	Part	Adjustable Plate - Discharge Line Support	1	101-0277
F	Part	3/8" Lock Washer	4	09-5106
G	Part	Discharge Line Support Mounting Plate	1	101-0023
H	Part	1/2" Lock Washer	2	09-5110
J	Part	Adjustable Plate - Inlet Line Support	1	101-0022
K	Weldment	Inlet Line Support Mounting Base	1	101-1138
L	Part	3/8" UNC Thin Nylock Nut	6	09-
M	Part	3/8" Narrow Flat Washer	6	09-5124
N	Part	3/8" UNC x 1-1/4" Hex Bolt	2	09-1048
P	Weldment	Valve Handle Guard	1	CE-HANDLE-2
Q	Part	1/2" Flat Washer	1	09-5010
R	Part	1/2" UNC Thin Nylock Nut	1	09-5610S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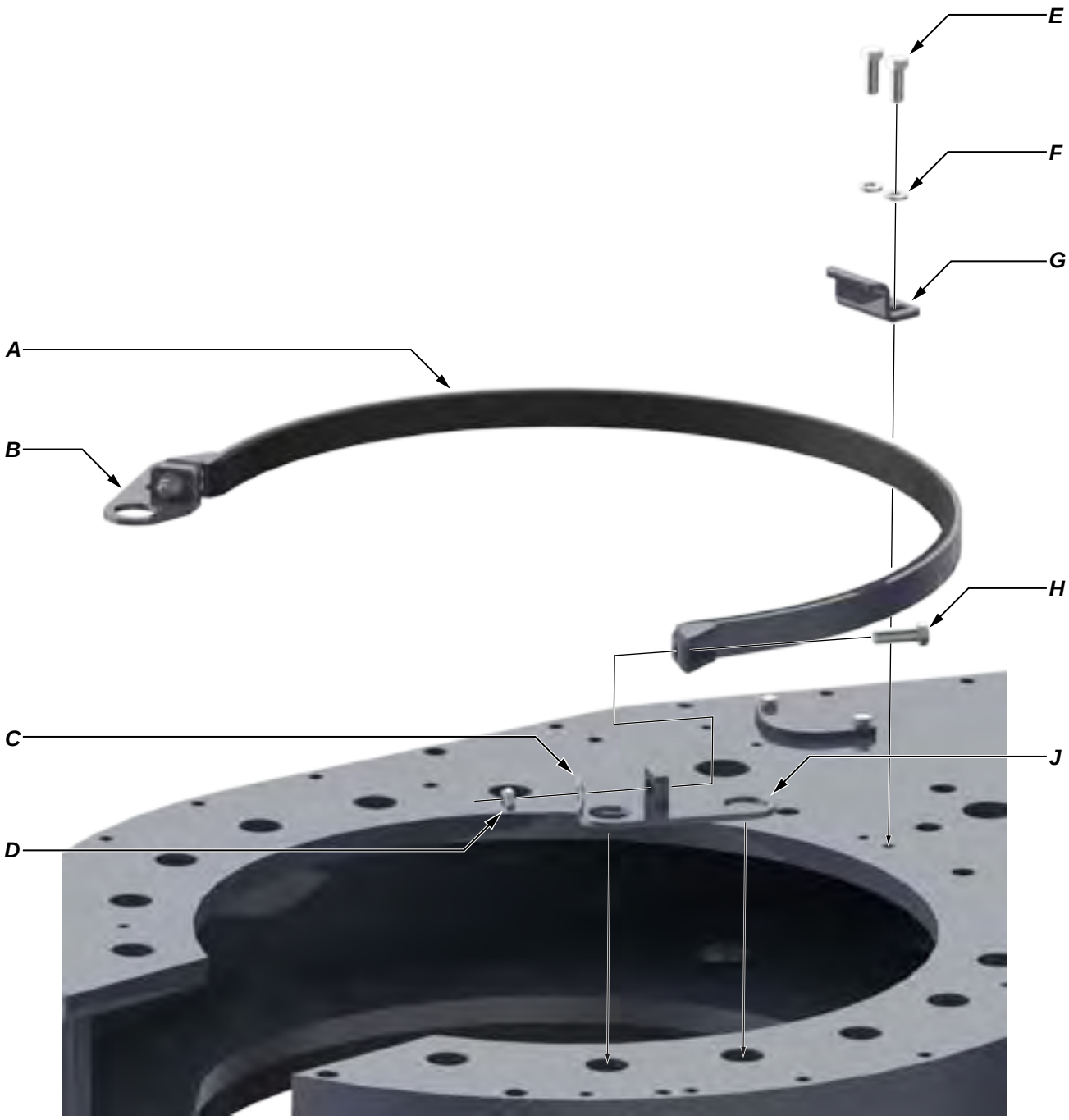
Item	Type	Description	Qty	Part Number
A	Weldment	Torque Gauge Mount Weldment	1	1500-09-03A
B	Part	1/2" UNC x 1-1/4" Hex Socket Head Cap Screw	2	09-2168
C	Part	1/2" UNC x 1" Hex Socket Head Cap Screw	2	09-2166
D	Part	1/2" Lock Washer	4	09-5110
E	Part	Hydraulic Motor	1	87-0112
F	Part	Motor Gear	1	997-A10-149
G	Part	3/8" UNC x 3/8" Hex Socket Set Screw	2	09-0106
H	Part	1/2" UNC x 1-1/2" Hex Socket Head Cap Screw	4	09-2170
J	Part	1/8" NPT 90° Grease Fitting	1	02-0093
K	Part	Motor Mount	1	1050-150
L	Part	#20 (1-1/4")/JIC 1" Flange Elbow	2	02-9216
M	Part	0.148" x 2.938" Hitch Pin	1	
N	Part	#20 (1-1/4") Split Flange Kit	2	02-9217
	Part	O-Ring	1	
	Part	#20 (1-1/4") Split Flange	2	
	Part	7/16" Lock Washer	4	
	Part	7/16" UNC x 1-1/2" Hex Bolt	4	
P	Weldment	Torque Gauge Holder Weldment	1	1500-09-04A
Q	Part	5/16" x 5/16" x 1-1/2" Square Gear Key	1	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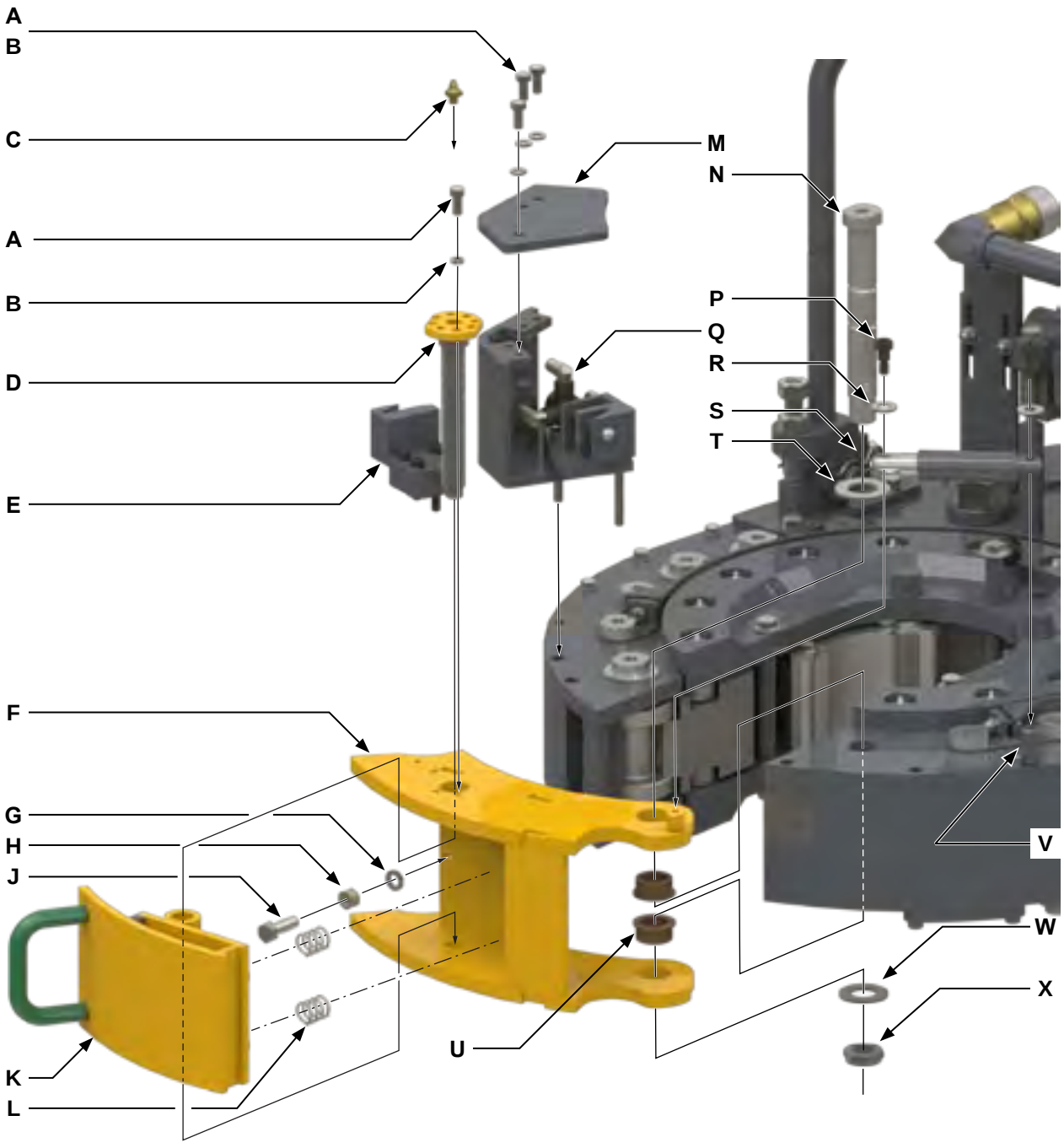
Item	Type	Description	Qty	Part Number
A	Weldment	Lined Brake Band Weldment	2	1050-D4-29
B	Weldment	Brake Band Lug Weldment (Top Right, Bottom Left)	2	101-0096
C	Part	3/8" Narrow Flat Washer	4	09-5124
D	Part	3/8" UNC Thin Nylock Nut	4	
E	Part	3/8" x 1" Hex Cap Screw	4	09-1046
F	Part	3/8" Lock Washer	4	09-5106
G	Part	Brake Band Retainer	2	101-0140
H	Part	3/8" UNC x 1-1/4" Hex Bolt	4	09-1048
J	Weldment	Brake Band Lug Weldment (Bottom Right, Top Left)	2	101-0083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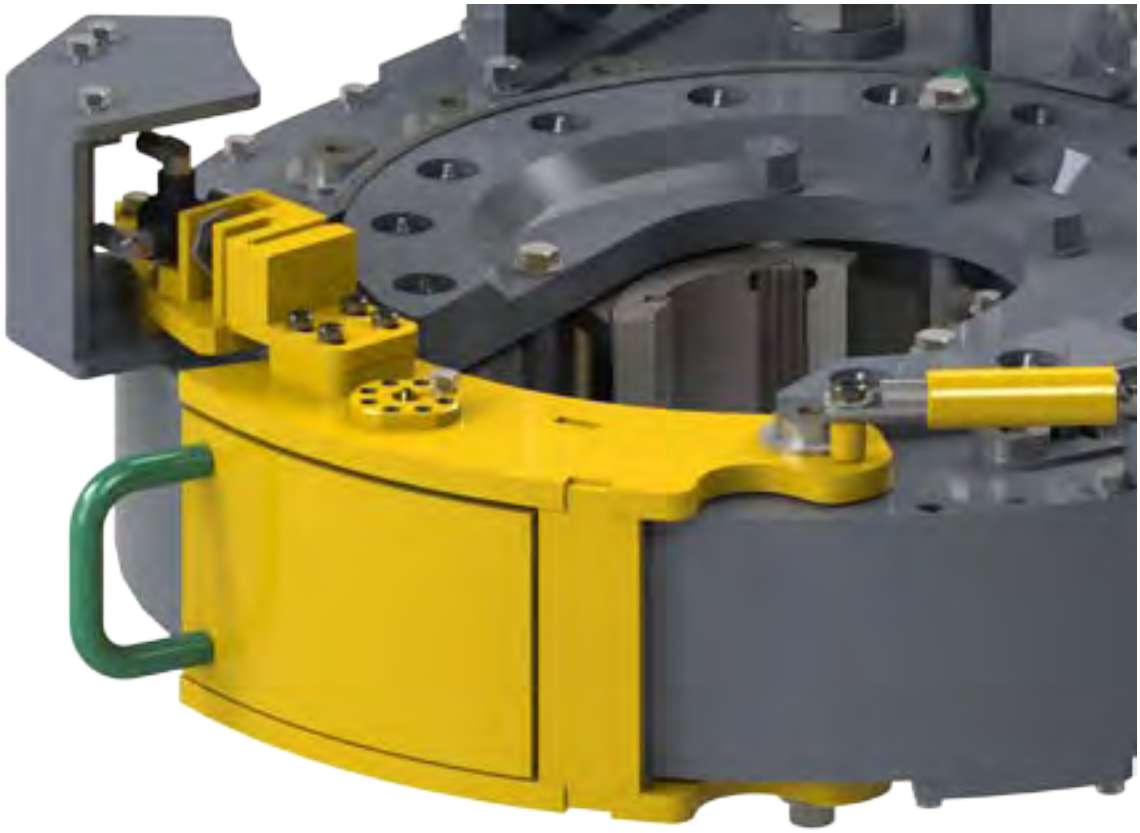
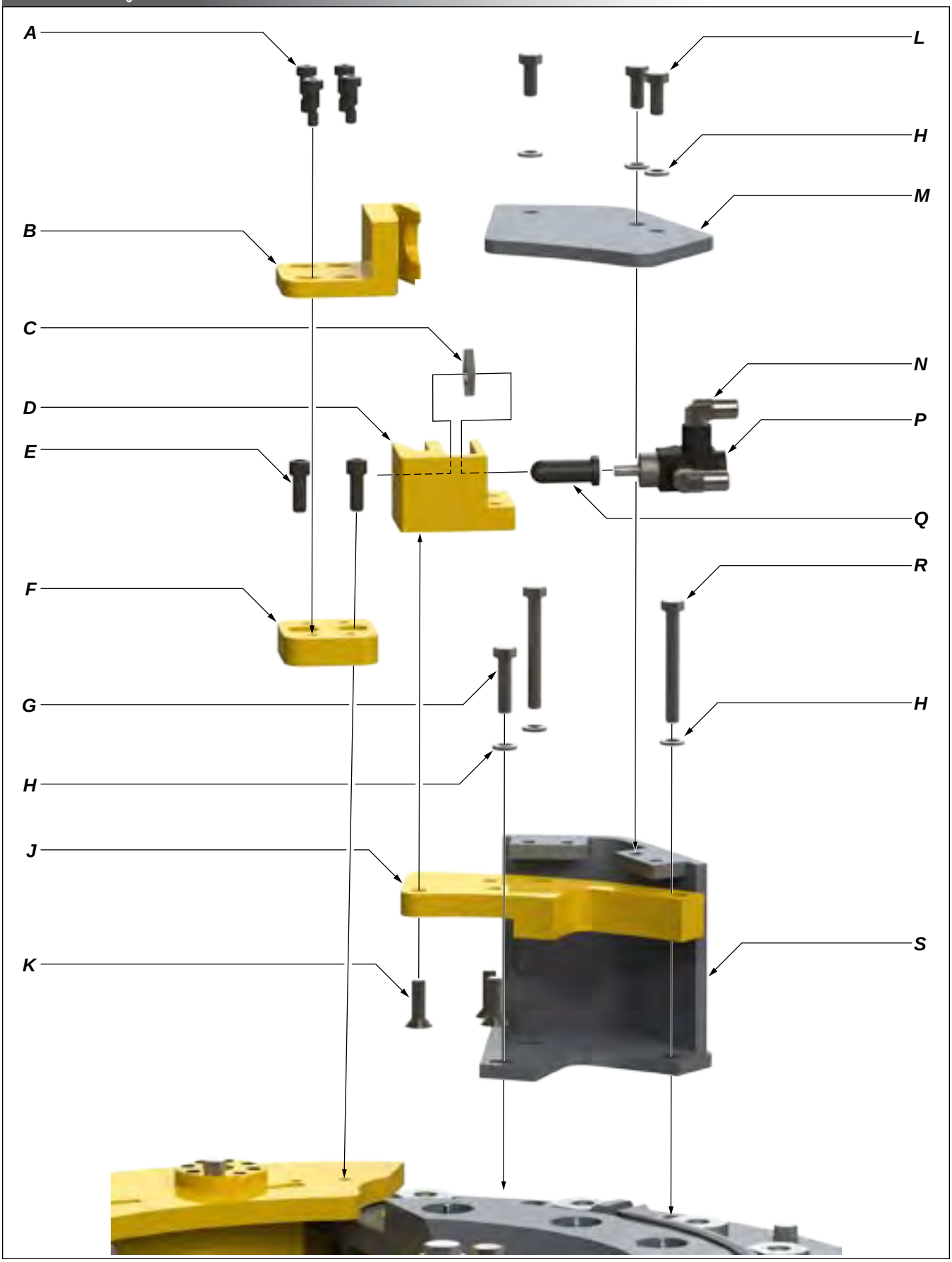


Item	Type	Description	Qty	Part Number
A	Part	3/8" UNC x 3/4" Hex Bolt	4	09-1044
	Part	CE-MARKED: 3/8" UNC x 3/4" Hex Bolt, SSD	3	09-1044SSD
B	Part	3/8" Carbon Steel Lock Washer	4	09-5106
C	Part	1/8" NPT Grease Fitting	1	02-0005
D	Part	Adjustment Cam	1	1037-A-14
E	Assembly	Safety Door Latch Block Assembly (Pp. 5.30 - 5.31)	1	
F	Weldment	Door Weldment	1	1050-C4-10
G	Part	1/2" Lock Washer	1	09-5110
H	Part	1/2" UNC Hex Nut	1	09-9124
J	Part	1/2" x 1-3/4" Hex Bolt	1	09-2172
K	Weldment	Door Latch Weldment	1	1050-15
L	Part	Latch Spring	2	997-16
M	Part	Switch Guard Top Plate	1	101-1474
N	Part	Door Pivot Support Roller Shaft	1	101-3940
P	Part	1/2" x 1/2" Hex Socket Shoulder Bolt UNC	2	02-0973
Q	Assembly	Safety Door Latch Switch Assembly (Pp. 5.30 - 5.31)	1	
R	Part	1/2" Narrow Flat Washer	2	09-5119
S	Assembly	Door Cylinder	1	101-0069
T	Part	1 1/8" Narrow Washer (Door Pivot Roller)	1	02-0471
U	Part	Shoulder Bushing	2	101-0110
V	Part	Door Cylinder Mounting Lug	1	1050-12-001
W	Part	1" Narrow Washer (Door Pivot Roller)	1	09-5120
X	Part	1" UNS Thin Nylock Nut (Door Pivot Roller)	1	09-9167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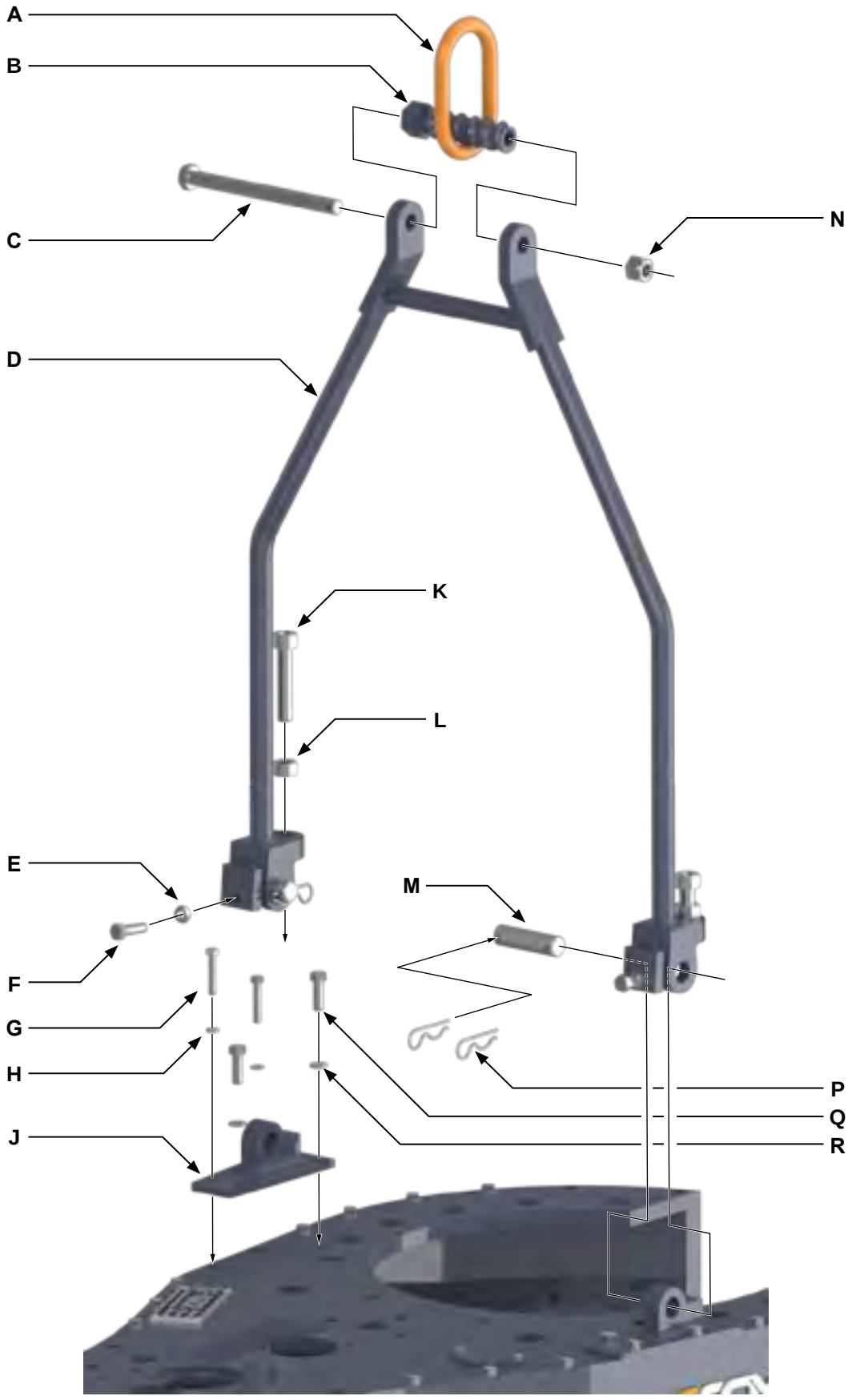
Item	Type	Description	Qty	Part Number
A	Part	3/8" x 1/2" Shoulder Bolt, UNC	4	09-0125
B	Part	Safety Door Latch Block	1	101-1104
C	Part	15/16" Valve Lock Nut	1	09-0278
D	Part	Safety Door Latch Block	1	101-1103
E	Part	3/8" UNC x 1" Hex Socket Head Cap Screw	2	09-1738
F	Part	Safety Door Latch Spacer	1	101-1411
G	Part	3/8" UNC x 1-1/2" Hex Bolt	1	09-1553
H	Part	3/8" Carbon Steel Lock Washer	6	09-5106
J	Part	Safety Door Latch Plate	1	101-1410
K	Part	3/8" UNC x 1" Hex Socket Flat Countersunk Cap Screw	3	09-4046
L	Part	3/8" UNC x 3/4" Hex Bolt	4	09-1044
M	Part	Switch Guard Top Plate	1	101-1474
N	Part	1/4" NPT - JIC 90 degree elbow 2024-4-4	3	08-0284
P	Part	Safety Door Switch	1	08-0337M
Q	Part	Load Plunger	1	AE12-306
R	Part	3/8" UNC x 3" Hex Bolt	2	09-1058
S	Weldment	Safety Door Switch Guard Weldment	1	101-1475

CE-Marked tongs use the following parts in place of those in the previous table:

Item	Type	Description	Qty	Part Number
A	Part	3/8" x 1/2" Shoulder Bolt, UNC, SS Drilled	4	09-0125SSD
G	Part	3/8" UNC x 1-1/4" Hex Bolt, SS Drilled	1	09-1048SSD
L	Part	3/8" UNC x 3/4" Hex Bolt, SS Drilled	4	09-1044SSD
R	Part	3/8" UNC x 3" Hex Bolt, SS Drilled	2	09-1058SSD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ALL FASTENERS USED TO ASSEMBLE LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS) MUST BE TIGHTENED TO THE CORRECT TORQUE.

See Page 3.12

Rigid Sling Weldment - CE Marked Tong

Item	Type	Description	Qty	Part Number
A	Part	Lifting Link	1	02-0516
B	Part	Rigid Sling Adjustment Helix	1	1053-1-H
C	Part	3/4" NC x 9" Hex Bolt	1	09-1322
D	Weldment	Rigid Sling Weldment	1	101-0112
E	Part	1/2" NC Hex Jam Nut	2	09-5810
F	Part	1/2" NC x 1-3/4" Hex Bolt	2	09-1172
G	Part	3/8" NC x 2" Hex Bolt	4	09-1046
H	Part	3/8" Helical Lock Washer	4	09-5106
J	Weldment	LH Rigid Sling Bracket	1	101-0113
	Weldment	RH Rigid Sling Bracket	1	101-0115
K	Weldment	Level Adjustment Bolt	2	1053-C-1L
L	Part	3/4" UNC Hex Nut	2	09-5818
M	Part	Rigid Sling Pin	2	1053-C-1C
N	Part	3/4" NC Nylock Nut	1	1429-39-02
P	Part	3/16" Hitch Pin	4	02-0028
Q	Part	1/2" UNC x 1-1/2" Hex Bolt	4	09-1170
R	Part	1/2" Lock Washer	4	09-5110

CE-Marked tongs use the following parts in place of those in the previous table:

Item	Type	Description	Qty	Part Number
D	Weldment	Rigid Sling Weldment	1	101-0112-CE
G	Part	3/8" UNC x 2" Hex Bolt, SS Drilled	4	09-1054SSD
Q	Part	1/2" UNC x 1-1/4" Hex Bolt, SS Drilled	4	09-1168SSD

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A. BASIC TORQUE MEASUREMENT

Basic torque measurements are performed using a simple hydraulic measurement system. A hydraulic load cell connects to a calibrated torque gauge through a reinforced flexible hydraulic hose. The torque gauge is factory-calibrated to display accurate torque measurements for a tong or tong and backup assembly with a particular arm length. The arm length is a measurement from the centre of the pipe or casing to the centre of the force being applied to the load cell.

Two load cell options are available. A tension load cell is typically used with a suspended stand-alone tong. This application requires that the load cell be attached to the rear of the tong as part of the restraint line that opposes the force generated when the tong makes up or breaks out a joint. A compression load cell is used in a tong and backup assembly, and is typically located on the rear of the backup between the backup and a stationary frame. The load cell must be located in the centre of the compression force vector generated between the backup and the frame.

Hydraulic force generated by a load cell is transmitted to the torque gauge via a reinforced flexible hydraulic line. The hydraulic force is displayed as torque in units of Ft.-Lbs. The torque gauge has a red "peak torque" indicator that tracks with the torque gauge needle to the point of highest torque, and remains at the point of highest torque until manually reset. Note that every model of tong and tong and backup assembly has a unique arm length, and the torque gauge must be calibrated for that arm length. Torque gauges that are not calibrated for the arm length of the tool in service will not display correct torque. To ensure correct torque measurement, ensure the arm length or "handle" as displayed on your torque gauge matches the arm length of the tool in service as listed on the specifications page of the technical manual.

The images on this page are for illustration purposes only and may not accurately represent the torque gauge and load cell that have been supplied with your equipment.

THE IMAGES DISPLAYED ARE SUPPLIED FOR ILLUSTRATION PURPOSES ONLY

ILLUSTRATION 6.A.1: TORQUE GAUGE (FOR ILLUSTRATION PURPOSES ONLY)

ILLUSTRATION 6.A.2: TENSION LOAD CELL

ILLUSTRATION 6.A.3: COMPRESSION LOAD CELL

Torque gauges and load cells are supplied as a matched calibrated pair. Substituting one or the other will render the calibration inaccurate even if the actual model numbers appear to be identical. The serial numbers of matching load cell and torque gauges are clearly identified on the calibration certificate. Should you suspect the accuracy of your torque measurements, or wish to replace either component the pair should be returned to the factory for re-calibration before placing into service.

TORQUE GAUGES AND LOAD CELLS ARE FACTORY-SUPPLIED AS MATCHED CALIBRATED PAIRS. IF REPLACING EITHER COMPONENT THE LOAD CELL AND TORQUE GAUGE MUST BE RETURNED TO THE FACTORY FOR RE-CALIBRATION BEFORE PLACED INTO SERVICE.

BASIC TORQUE MEASUREMENT (Continued:)

The images on the preceding page are for illustration purposes only and may not accurately represent the torque gauge and load cell that have been supplied with your equipment. Please note that the parts listed in the following table are correct for accurate torque measurement while using the equipment for which this manual is supplied.

THE TORQUE GAUGE USED IS FULLY DEPENDANT UPON THE ARM LENGTH AND TORQUE RANGE OF THE EQUIPMENT IN USE. THE PART NUMBERS LISTED IN THE FOLLOWING TABLE ARE CORRECT FOR ACCURATELY MEASURING TORQUE USING THE EQUIPMENT FOR WHICH THIS MANUAL IS SUPPLIED.

Item	Type	Description	Qty	Part Number
	Assembly	36" Arm-30K Tension Load Cell and Gauge	1	10-0017T
A	Part	4.08 in^2 Tension Load Cell	1	10-0008T
B	Part	Torque Gauge, 30,000 Ft.-Lbs. 36" Arm	1	10-0017G
C	Part	Hydraulic Hose	1	02-0069

LOAD CELLS ARE NOT USER SERVICEABLE. ILLUSTRATION 6.A.4 IS PROVIDED FOR INFORMATION PURPOSES ONLY. DAMAGED LOAD CELLS MUST BE RETURNED TO THE FACTORY FOR REPAIR AND RE-CALIBRATION.

ELECTRONIC LOAD CELLS ARE NOT PERMITTED FOR USE WITH CE MARKED EQUIPMENT

Item	Type	Description
	Assembly	Tension Load Cell, 4.08 in^2
A	Part	1/4" NC x 1/2" Binding Head Machine Screw
B	Part	Stat-O-Seal
C	Part	O-Ring
D	Part	O-Ring
E	Part	Load Cell Piston
F	Part	Flange Gasket
G	Part	Load Cell End
H	Part	Load Cell Rod
J	Part	Wiper
K	Part	O-Ring
L	Part	Load Cell Body
M	Part	3/8" NC x 3/8" Cup Point Hex Set Screw
Seal Kit		Replacement Seal Kit 4.08 in^2 Tension Load Cell

This is the standard tension load cell supplied by McCoy Drilling & Completions | Farr. Contact our sales department for information about optional application-specific tension load cells.

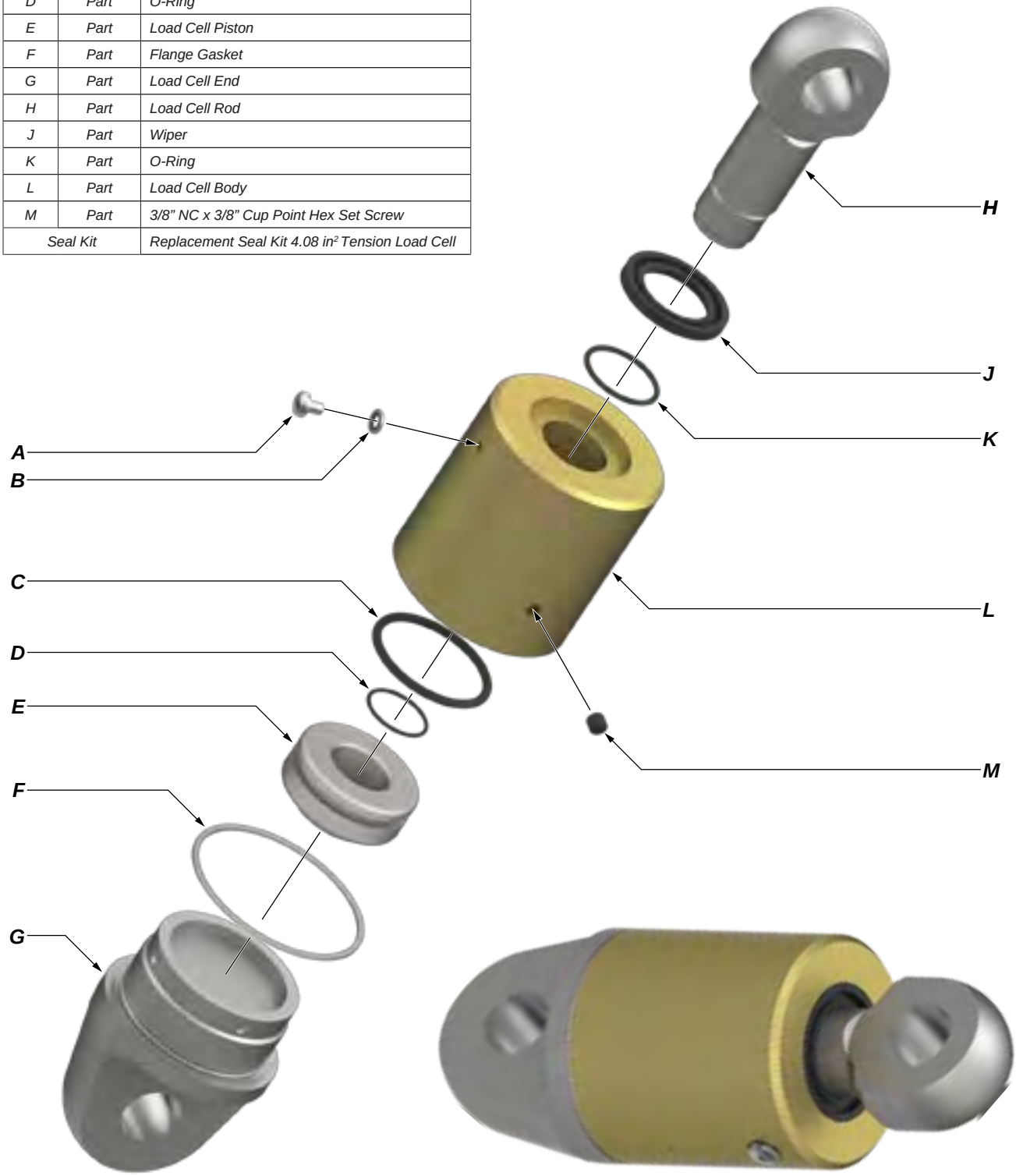
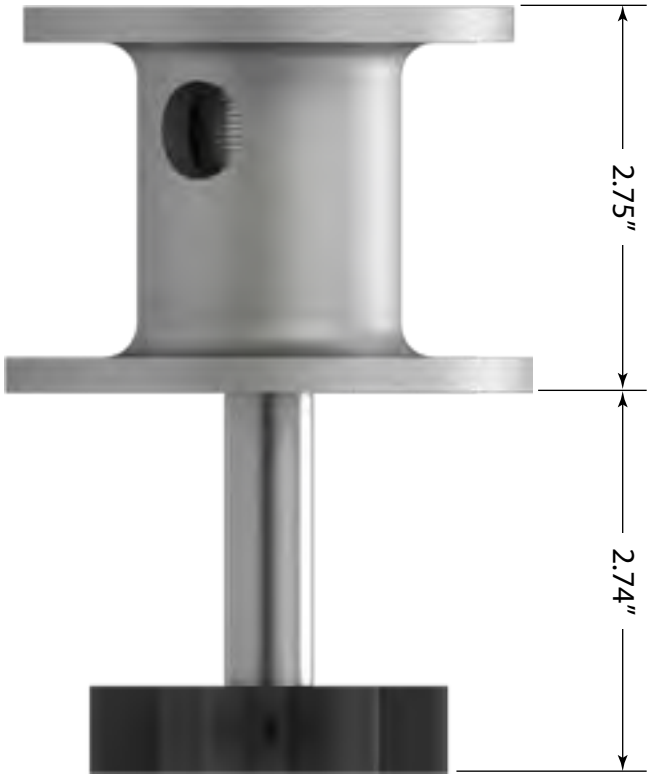
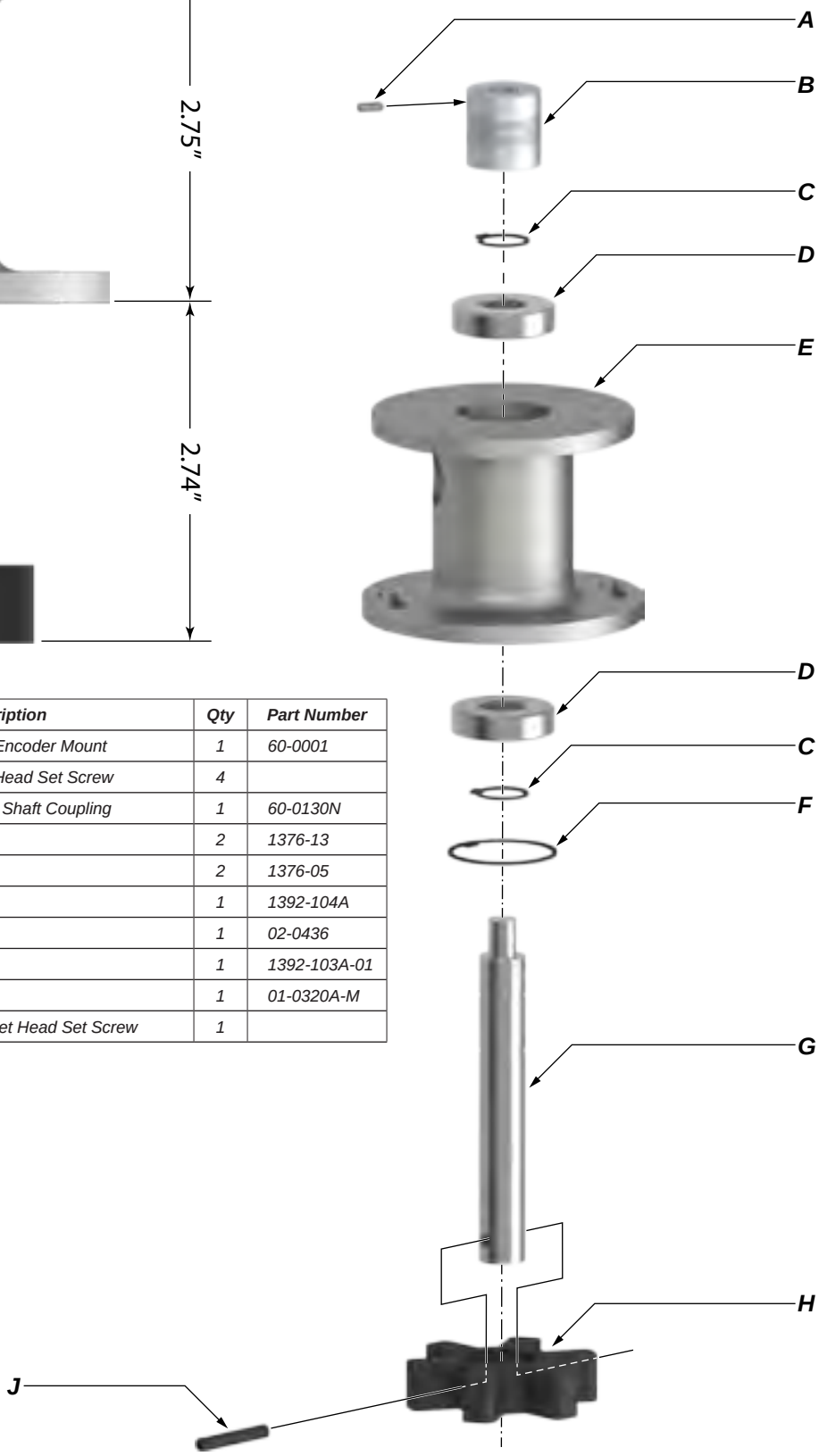


ILLUSTRATION 6.A.4: TENSION LOAD CELL





Item	Type	Description	Qty	Part Number
	Assembly	Standard Turn Counter Encoder Mount	1	60-0001
A	Part	6-32 x 3/8" Hex Socket Head Set Screw	4	
B	Part	Helical Flexible Encoder Shaft Coupling	1	60-0130N
C	Part	Internal Retainer Ring	2	1376-13
D	Part	Bearing	2	1376-05
E	Part	Encoder Housing	1	1392-104A
F	Part	Internal Retainer Ring	1	02-0436
G	Part	Encoder Shaft	1	1392-103A-01
H	Part	Encoder Gear	1	01-0320A-M
J	Part	10-24 x 1-1/4" Hex Socket Head Set Screw	1	

ILLUSTRATION 6.A.5: TURN COUNTER ENCODER MOUNT

B. TROUBLESHOOTING

Under normal operating conditions, and with proper maintenance, the torque gauge and load cell system are designed to give lasting trouble-free performance. Faulty indication on the gauge will very often define a fault within the gauge.

IF TROUBLESHOOTING REVEALS THAT THERE IS INSUFFICIENT FLUID IN THE SYSTEM, BEFORE RECHARGING, CHECK THAT ALL SYSTEM COMPONENTS ARE FREE FROM DAMAGE. THIS WILL ENSURE THAT FLUID LOSS WILL NOT CONTINUE AFTER RELOADING

1. Symptom: No indication on gauge.

Possible Problem: Obstruction in hydraulic hose.

Solutions: Check hydraulic hose for kinks.
Replace hydraulic hose.

Possible Problem: Loss of hydraulic fluid.

Solution: Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

Possible Problem: Internal mechanism of torque gauge is damaged.

Solution: Replace gauge.

2. Symptom: Gauge indication unexpectedly high.

Possible Problem: Excessive hydraulic fluid.

Solutions: Completely drain hydraulic fluid from torque gauge/load cell system. Recharge following the procedure in Section 6.C.

Possible Problem: Internal mechanism of gauge is damaged.

Solution: Replace gauge.

Possible Problem: Incorrect torque gauge in use (not part of the original torque gauge/load cell pair).

Solution: Replace gauge with gauge properly calibrated for the load cell in service.

3. Symptom: Gauge indication unexpectedly low

Possible Problem: Insufficient hydraulic fluid.

Solution: Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

Possible Problem: Obstruction in hydraulic hose.

Solutions: Check hydraulic hose for kinks.

Replace hydraulic hose.

Possible Problem: Snub line not at right-angle to tong handle.

Solution: Check angle of snub line and correct if necessary.

Possible Problem: Internal mechanism of gauge is damaged.

Solution: Replace gauge.

Possible Problem: Incorrect torque gauge in use (not part of the original torque gauge/load cell pair).

Solution: Replace gauge with gauge properly calibrated for the load cell in service.

4. Symptom: Gauge indication is erratic or sluggish

Possible Problem: Insufficient hydraulic fluid in torque measurement section.

Solution: Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

Possible Problem: Loss of damping fluid in torque gauge.

Solution: Top up or refill damping fluid (NOTE: Ensure leakage points in gauge are identified and repaired to prevent further loss of damping fluid).

Possible Problem: Air bubbles in hydraulic fluid in the torque measurement system.

Solution: Bleed air from load cell and torque gauge and top up fluid (if necessary) as per Section 6.C.

Possible Problem: Internal mechanism of gauge is damaged.

Solution: Replace gauge.

C. PERIODIC INSPECTION AND MAINTENANCE

ONLY QUALIFIED, DESIGNATED PERSONNEL ARE PERMITTED TO PERFORM MAINTENANCE ON THE TORQUE MEASUREMENT SYSTEM.

1. Inspection

The torque measurement system supplied with your equipment is designed and built to provide years of trouble-free service with minimum maintenance. Periodic inspections of the load cell, hydraulic lines and fittings are recommended in order to keep the system in top operating condition. A thorough inspection should be made at each rig-up.

2. Fluid Recharge

Recharge hydraulic system with W15/16 fluid through the check valve on the torque indicating gauge. Recharging must only be performed when there is no load on the load cell. Refer to the illustrations on pages 6.3 & 6.4 for guidance if required.

a. *Place the torque indicating gauge higher than the load cell. Remove the brass 1/4" cap from the fitting on the check valve on the top of the gauge.*

b. *Connect the hand pump to the check valve fitting.*

c. *Elevate the load cell so it is higher than the torque gauge and hand pump.*

UN-CONTAINED SPILLAGE OF THE HYDRAULIC FLUID IN THIS SYSTEM MAY CONTRAVENE GOVERNMENTAL ENVIRONMENTAL REGULATIONS, OR THE ENVIRONMENTAL REGULATIONS AND POLICIES OF YOUR COMPANY. FARR CANADA CORP. HIGHLY RECOMMENDS PLACING YOUR LOAD CELL IN A CONTAINMENT BASIN BEFORE PROCEEDING WITH THE BLEEDING & REFILLING PROCESS.

d. *Fill hand pump bowl with W15/16 hydraulic fluid.*

MAINTAIN GREATER-THAN HALF FULL FLUID LEVEL IN THE HAND PUMP BOWL TO AVOID PUMPING AIR INTO THE SYSTEM. DO NOT ALLOW THE LEVEL TO FALL BELOW ONE-HALF FULL

e. *Remove the vent plug screw and Stat-O-Seal (Items C and D on Illustration 6.A.4, or item H on Illustration 6.A.5) to allow trapped air to escape.*

f. *Pump fluid into the system until no more air is seen escaping from the vent port.*

g. *Replace the vent plug screw and Stat-O-Seal and tighten securely.*

h. *Remove load cell from containment vessel and wipe clean. Reclaim the hydraulic fluid (if it is clean) or dispose of all waste materials according to governmental or your company's proscribed environmental protection regulations.*

i. *Disconnect the hand pump from the torque gauge.*

j. *Replace the brass cap on the torque gauge check valve fitting.*

3. Reference Checking Your Torque Measurement System

The following steps define a process for determining if your torque measurement system is correctly measuring and indicating within an expected range. This procedure is best suited for performing in a shop or location removed from the drill floor, within range of a crane. This is a reference check and not a calibration. Calibrations must be performed at an authorized calibration facility.

Tension Load Cell

a. *Locate a known weight in the range of approximately 500 to 1000 lbs (227 to 455 kg), and move the weight next to the tong and backup assembly.*

b. *Remove the tension load cell from the tong, but do not disconnect from the torque gauge.*

c. *Suspend the load cell, piston side up, from a crane capable of supporting the known weight in Step 3a.*

d. *Connect the rod side of the load cell to the known weight, and use the crane to hoist the weight from the surface to be suspended freely.*

Continued on next page...

Reference Checking Your Torque Measurement System (continued):

Tension Load Cell (continued):

e. *Perform a simple calculation to determine the expected indication on the torque gauge based on the known hoisted weight. This is a calculation that must be performed using imperial units (eg., pounds and feet). The calculation is: [KNOWN WEIGHT] x [ARM LENGTH (in feet)]. For example, if the arm length is 36 inches and the hoisted weight is 1000 lbs the calculation is:*

1000 x (36/12) = 3000

Therefore, the expected indication on the torque gauge should be 3000 lbs-ft.

4. Repair And Calibration

Return the load cell and indicator gauge to the authorized repair facility for repairs and calibration.

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MOVING GLOBAL ENERGY FORWARD

DRILLING & COMPLETIONS

FARR

Section 7: Hydraulic Component Information

The manufacturer information contained in this section has been obtained from publicly available web sites and has been provided for information purposes only. McCoy Drilling & Completions does not guarantee the accuracy of the information contained in this section. All original copyrights claimed by the manufacturer(s) apply.

MANUFACTURER OF HYDRAULIC MOTORS
RINEER® HYDRAULICS, INC.

15 series

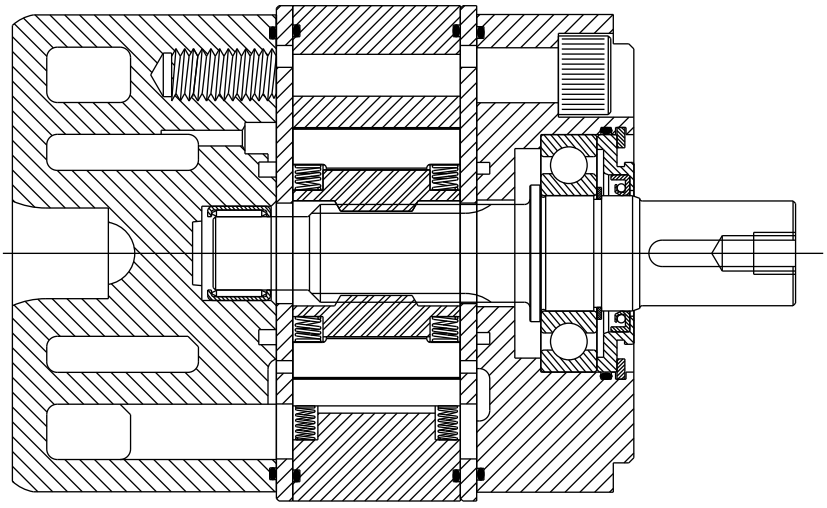
POWER to be the Best!

MOTOR SELECTION GUIDE

Features of the 15 Series Standard Motor: Standard Motor - 3000 PSI (Code 61)

- Eight fixed displacement motors ranging from 6 in^3 to 15 in^3.
- Starting and stall torques equal to 90-94% of theoretical torque.
- Speed to 2,000 RPM continuous.
- Up to 75 HP continuous.
- Conforms to SAE 'C' mounting specification.
- Weighs 43 lbs.

CROSS SECTION

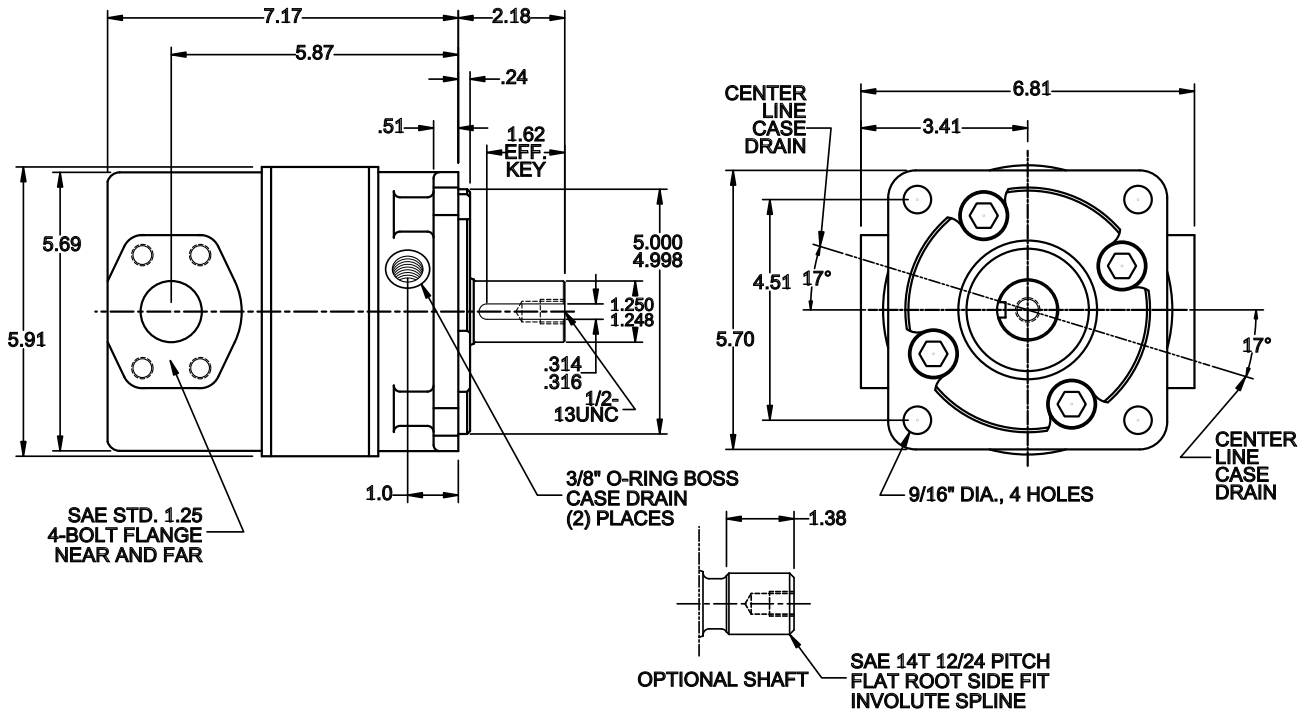


Made in USA

PUBLICATION DS151005 8/03

MCCOY MOVING GLOBAL ENERGY FORWARD | DRILLING & COMPLETIONS

15 Series Standard Motor Envelope



Technical Information - All Styles

VANE CROSSING VANE
The Rineer patented vane crossing vane design produces much higher volumetric and mechanical efficiencies than is possible with a standard vane type design. This design provides a sealing vane between cavities to improve mechanical and volumetric efficiencies.

STARTING AND STALL TORQUE
The Rineer motor produces torque curves which are virtually flat, with starting and stall torque equal to approximately 90-94% of theoretical torque.

MORE POWER STROKES PER REVOLUTION
The 15 Series has four stator cavities and 10 rotor vanes. Each rotor vane works in each stator cavity once per revolution, which results in 40 power strokes per revolution. This helps produce higher mechanical efficiency and flatter torque curves.

BEARING LOADING
The bearings in the 15 Series can accept radial load per the radial capacity chart. Thrust load is not recommended under most conditions. Consult with a Rineer Application Engineer for optional bearing configurations to match your application.

SEALS
Buna N seals are supplied as standard on the Rineer 15 series motors. Viton seals may be ordered as an option.

ROTATING GROUP - 1S or 1H
Under most operating conditions, 1S (standard rotating group parts) should be used. Under some high speed conditons 1H can be specified.

ROTATION
The 15 Series Motor rotates equally well in either direction and smoothly throughout its entire pressure and speed range. Looking into the end of the shaft, rotation is clockwise when oil is supplied to port "A".

HORSEPOWER LIMITATION
Maximum horsepower limitations may vary with different applications. ***When using the 15 Series Motor above 75 HP, consult a Rineer Application Engineer.***

FILTRATION
25 micron minimum.

FLUID
We suggest premium grade fluids containing high quality rust, oxidation and foam inhibitors, along with anti-wear additives. For best performance, minimum viscosity should be maintained at 100 SSU or higher. Fluid temperature should not exceed 180° F. Elevated fluid temperature will adversely affect seal life while accelerating oxidation and fluid breakdown. Fire resistant fluids may be used with certain limitations. Contact Rineer for additional information.

CASE DRAIN
The 15 Series Motor is designed for either internal or external case drain. Two case drain ports are supplied. When using internal case drain, simply plug the two ports. When using external case drain, use the port at the highest elevation. We recommend case drain pressure of 35 PSI or less when using the standard seals.

CASE DRAIN CIRCULATION
Fluid should be circulated through the case when a temperature differential exists between the motor and the system in excess of 50° F. ***Should this occur, contact a Rineer Application Engineer.***

MOUNTING
The mounting position is unrestricted. The shafts, pilots, and mounting faces should be within .002 TIR.

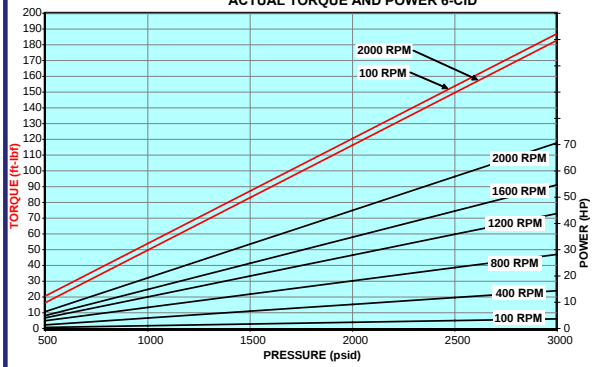
INTERMITTENT CONDITIONS
Intermittent conditions are to be less than 10% of every minute.

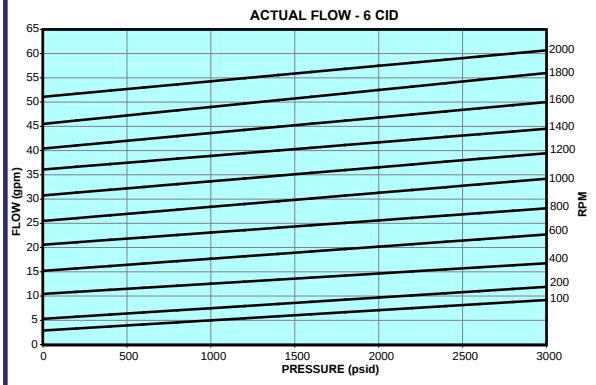
OTHER AVAILABLE MOTORS
For information on additional Rineer Motors, request one of the following publications:

37 Series .....Publication DS371003
57 Series .....Publication DS571003
125 Series .....Publication DS1251003

Performance Data - Selected Displacements

6 C.I.D.





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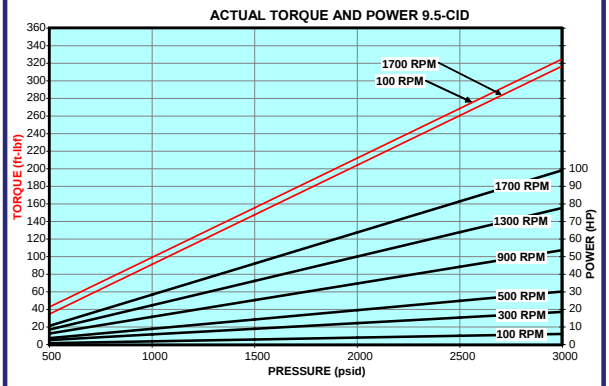

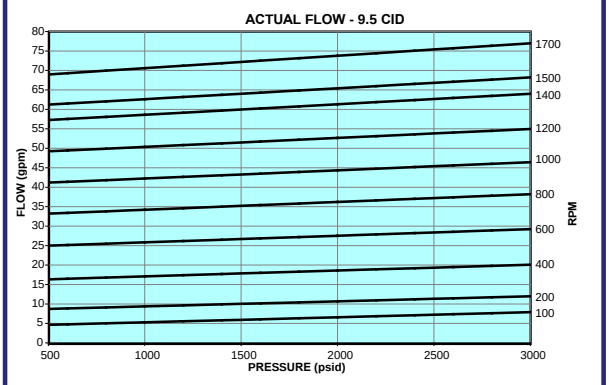

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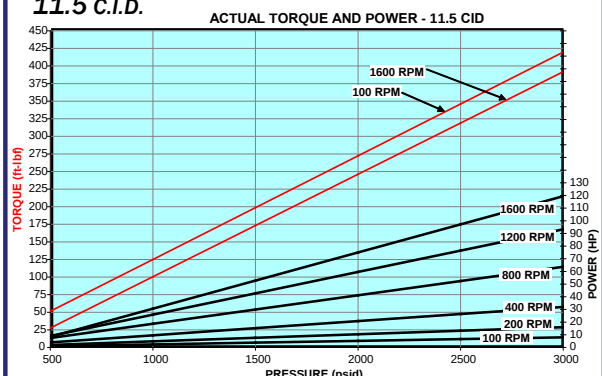

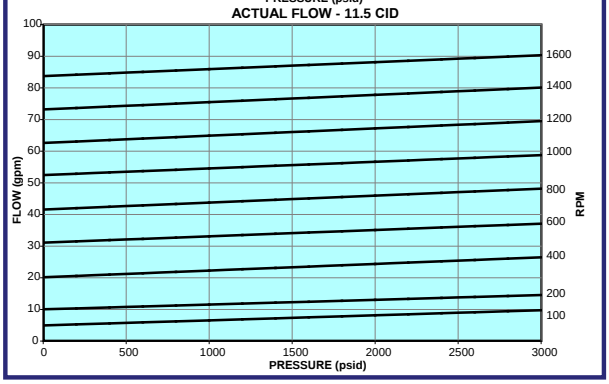

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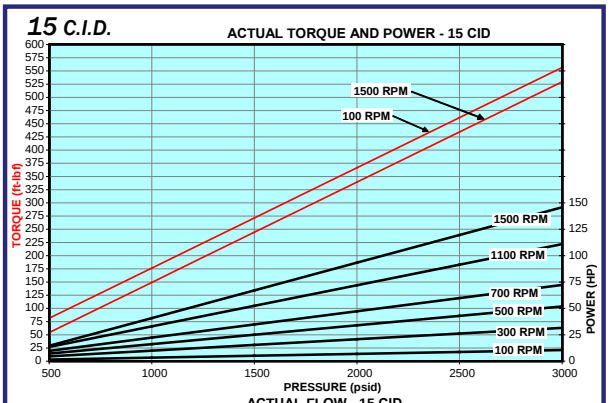
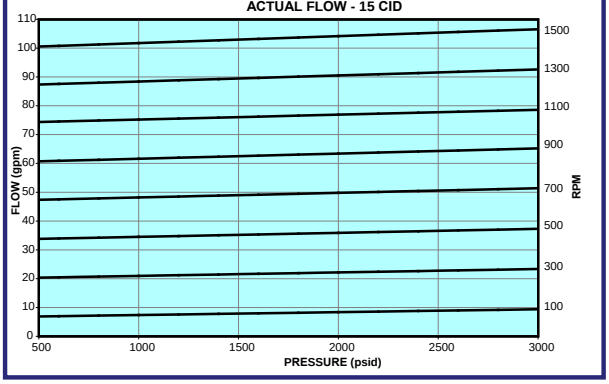




The above performance data was obtained at 140°F with ISO 46(DTE 25). These values must be maintained to obtain the performance indicated. Contact Rineer Hydraulics, Inc. for additional displacements.

Model Code

M015 - 61/62

M015 - 61 = 015 Single Speed
M015 - 62 = 015 Two Speed

Options:
62 = Two Speed Single Pilot Open During Crossover
63 = Two Speed Single Pilot Closed During Crossover
65 = Two Speed Double Pilot Open During Crossover
67 = Two Speed Double Pilot Closed During Crossover

-1S

1S = Std.
1H = High Speed

-015

006 = 6 in^3 (98cc)/rev.
007 = 7 in^3 (115cc)/rev.
008 = 8 in^3 (131cc)/rev.
009 = 9.5 in^3 (156cc)/rev.
010 = 10.5 in^3 (172cc)/rev.
011 = 11.5 in^3 (189cc)/rev.
013 = 13 in^3 (213cc)/rev.
015 = 15 in^3 (246cc)/rev.

-31

30 = Keyed Shaft
31 = Splined Shaft
32 = Wheel Motor
34 = Double Key
50 = Retractable
53 = API Thread

-B1

Bearing Package Selection

-TV

Seal - Package Selection

-000

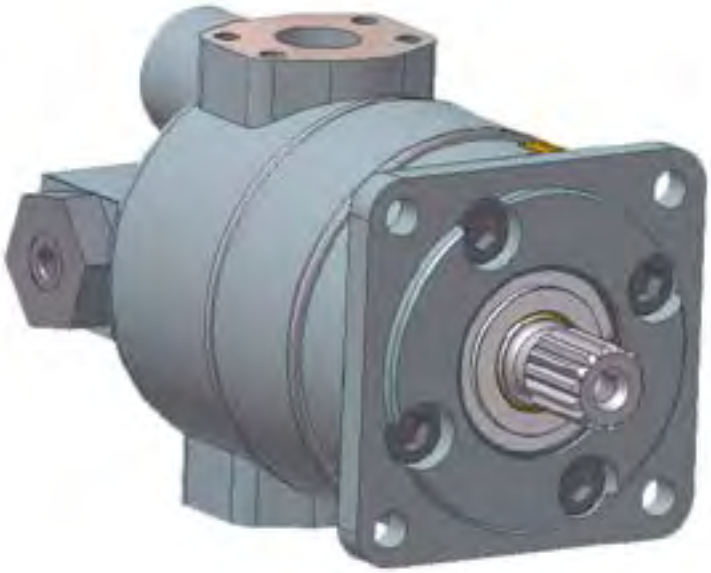
Special Code Designator

Applications

Repair Manual

15 Series

Standard Motor



Two Speed Motor

331 BREESPORT * SAN ANTONIO, TX 78216 * (210) 341-6333 FAX (210) 341-1231

SERIES 15 STD. MOTOR EXP. VIEW

ITEM	PART NO.	DESCRIPTION	QTY
1	0150111	SEAL PLATE SNAP RING	1
2	0150135	SEAL PLATE	1
3	0150161	SEAL, SHAFT, TCN	1
4		NOT USED	
5	0150114	SEAL PLATE O-RING	1
6	0150730	SNAP RING, BEARING	1
7	0150710	BALL BEARING	1
8	0150702	SHAFT, KEYED	1
	0150701	SHAFT, SPLINED	1
9	0150901	BOLT	4
10	0150102	FRONT HOUSING-INTERNAL	1
11	0150428	DOWEL PINS - FRONT	2
12	0150610	O-RING	4
13	0150902	BALL CHECKS	4
14	0150620	PLATE SCREW	4
15	0150608	PLATE	2
16	0150400	STATOR GA 11.5	1
	0150401	STATOR GA 15	1
	0150402	STATOR GA 13	1
	0150403	STATOR GA 9.5	1
	0150404	STATOR GA 8.0	1
	0150406	STATOR GA 7.0	1
	0150407	STATOR GA 6	1
	0150409	STATOR GA 3.0	1
17	0150300	ROTOR	1
18	0150313	ROTOR VANE	10
19	0150320	ROTOR VANE SPRING OUTER	20
20	0150321	ROTOR VANE SPRING INNER	20
21	0150410	STATOR VANE	4
22	0150420	STATOR VANE SPRING	8
23	0150429	DOWEL PINS - REAR	2
24	0150720	NEEDLE BEARING	1
25	0150800	REAR HOUSING	1

MODEL CODE: 015-61-15-015-30-B1-TB-XXX

STANDARD MOTOR

EXPLODED VIEW

SERIES: 15

RINEER HYDRAULICS
CORPUS CHRISTI, TEXAS

RECORD REFERENCE

DRAWN BY: JERRY W

DATE: 4-14-98

DWG. NO. 0150041

MCCOY MOVING GLOBAL ENERGY FORWARD | DRILLING & COMPLETIONS

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

REMOVAL OF SHAFT SEAL

1

1) Remove snap ring

WARNING: Use caution when removing snap ring. If released accidentally it can become an airborne hazard.

2

1) Pry out shaft seal plate with two screw drivers.
2) Remove seal plate o-ring from groove in bearing bore.

REMOVAL OF WHEEL MOTOR SEAL PLATE AND BEARING BOX

3

1) Loosen and remove 8 each 10-32 bolts.
2) Pry off seal plate with screw driver.

4

Loosen and remove 8 each 3/8" bolts with 5/16" socket head wrench.

5

1) Two of the 3/8" bolt holes are provided with jack screw threads.
2) Insert a piece of 1/4" round stock by 2-1/2" long into each jack screw hole
3) Screw two 7/16-14 bolts into the jack screw threads until the bearing box is free of the motor.

6

Lift up on the bearing box to remove from motor.

DISASSEMBLY OF WHEEL MOTOR BEARING BOX

7

1) Loosen clamp screw in lock nut.
2) Unscrew lock nut and remove.

8

1) Press shaft out of bearing box.
2) Proceed to step 9, disregarding steps 11 & 12

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

DISASSEMBLY OF FRONT HOUSING AND SHAFT

9

1) Mark one side of the motor for proper assembly, paying careful attention that the cartridge will not be installed upside down.
2) Secure the motor prior to loosening the 5/8-11 bolts.

10

1) Remove front housing
2) Note: Two 5/16" ball checks and one main body o-ring may be dislodged and fall free.

11

With the seal plate removed, press shaft and ball bearing out of front housing.

12

1) Remove snap ring from shaft.
2) Press shaft out of bearing.

DISASSEMBLY OF ROTOR/STATOR CARTRIDGE

13

Lift up rotor/stator cartridge and remove from the rear housing.

14

1) Place cartridge on any object which will hold it off the table.
2) Remove two each 10-32 place screws.
3) Remove timing plate.

15

1) Remove o-ring and springs with a small screwdriver.
2) Remove dowels pins.

16

1) Replace plate on rotor/stator cartridge.
2) Turn rotor/stator cartridge over.
3) Repeat steps 14 & 15.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

17

1) Remove the rotor.
2) Remove both the rotor and stator vanes.
3) Note: On motors manufactured prior to 1987, rotor vane slots and rotor vanes should be numbered so that vanes can be reassembled in the same vane slot.

INSPECTION AND REPLACEMENT OF PARTS

18

Inspect all springs and seals. We recommend replacement of all seals and springs whenever the motor has been disassembled.

19

Inspect all parts and replace any parts which obviously show excessive wear or damage.

20

VANES: Normal wear results in slight flattening of vane tips which does not impair motor performance. Replace vane if radius is reduced by 50%. Clearance between the rotor vane and rotor vane slot varies with the vane selection. The design allows the vane to "lean" slightly in the slot, providing the required mechanical seal.

21

PLATES: Normal wear results in marking of timing plates which does not impair motor performance. Replacement of the timing plate is required if any smearing, galling, or heat cracks are present.

22

ROTOR: Normal wear results in polishing of rotor faces which does not impair motor performance. Examine the rotor vane slots closely. Polishing down in the slots is normal, but if there is any indication of a "pocket" forming in the wall of the slot, the rotor should be replaced.

23

STATOR: Normal wear results in polishing of cam form which does not impair motor performances. Noticeable wear may be apparent along the corner of one side of the staor vane slot. This does not necessarily require replacement of the stator, but may slightly affect volumetric efficiency.

24

Note: Measure the rotor and stator length to the fourth decimal point and supply measurement when ordering rotor, stator, or vanes.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

ASSEMBLY OF ROTOR/STATOR CARTRIDGE

25

1) Reverse the procedures in steps 17, 16, 15, and 14
2) NOTE: Make sure that the radiused edge of each stator vane points to the rotor and the radiused edge of each rotor vane points to the stator.
3) NOTE: Make sure springs are seated in the bottom of the spring pocket in both the rotor and stator.

ASSEMBLY OF FRONT HOUSING

26

1) Press bearing onto shaft.
2) Install snap ring.

27

Press shaft and bearing assembly into front housing by pressing on the outer race of bearing.

28

1) Place seal in seal plate.
2) Place seal plate o-ring into groove in the front housing.
3) Press seal plate into front housing.
4) Install snap ring.
5) Proceed to step 30.

ASSEMBLY OF WHEEL MOTOR FRONT HOUSING

29

1) Reverse the procedures in steps 8 thru 3.
2) Screw lock nut onto shaft until all threads are engaged.
3) Tighten clamp screw until lock nut turns with a slight drag.
4) Tighten lock nut until desired rolling drag of bearing is obtained - see procedure Page 9.
5) Tighten clamp screw
6) Tighten all seal plate bolts.

ASSEMBLY OF MOTOR

30

1) Install dowel pins into rear housing.
2) Install ballchecks into rear housings.
3) Install main body o-ring.

31

1) Place rotor/stator cartridge onto rear housing.
2) NOTE: Make sure assembly marks from step 3 are lined up.

32

1) Install main body o-ring into front housing.
2) Install ball checks into front housing.
3) Place a small amount of grease over ball checks and o-ring.
4) Wipe off excess grease.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

33

1) Install dowel pins into rotor/stator cartridge.
2) Pour a small amount of clean oil into the cartridge.
3) Install front housing onto rotor/stator cartridge.
4) Make sure alignment marks are lined up.

34

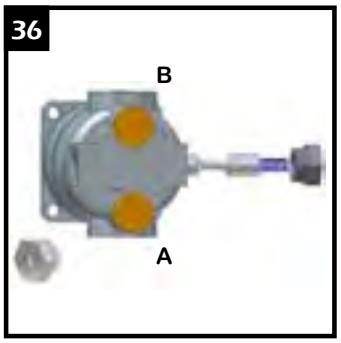
1) Install 5/8-11 bolts.
2) Torque bolts to 50 ft./lbs.

35

1) Rotate shaft in both directions to assure that the shaft turns smoothly.
2) Torque motor to 190 ft./lbs.
3) Rotate shaft again in both directions to assure that the shaft turns smoothly.

SPOOL ASSEMBLY FOR THE TWO SPEED MOTOR

36

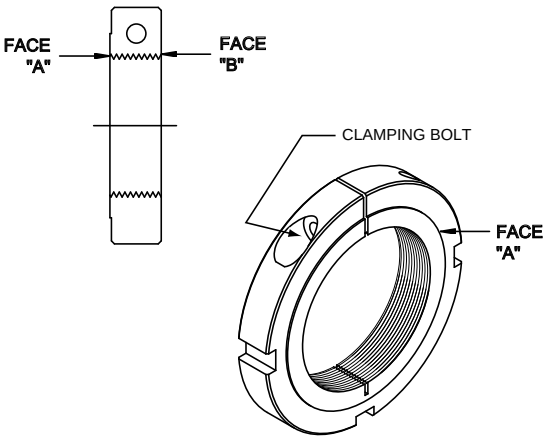


NOTE: Spool should be oriented as shown for two speed motors with model codes 62, 63, 68, & 69.

NOTE: Slight design variations may exist in motors manufactured either before or after the printing of this manual.

WHEEL MOTOR SHAFT AND BEARING ASSEMBLY PROCEDURE

1) Clean ALL assembly parts w/ lacquer thinner.
2) Dip clampnut and clamping bolt separately in lacquer thinner.
   (Steps 3 thru 10 must be conducted to completion ONE assembly at a time.)
3) Press bearing cups into bearing housing. Make sure they are pressed completely against bearing shoulders.
4) Coat inner race of large cone with #609 (green) Loctite and press cone onto the shaft. Make sure the cone is completely against the shoulder of the shaft.
5) Insert shaft and large cone into bearing housing.
6) Coat inner race of small cone with #609 (green) Loctite and press small cone onto shaft.
7) Apply #272 (red) Loctite to the clampnut threads of the shaft. Apply #242 (blue) Loctite to the threads of the clamping bolt and install in the clampnut.
8) Spin clampnut onto shaft with the "B" face towards bearings. After the nut threads are fully engaged, but prior to the nut contacting the bearings, tighten the clamping bolt until there is drag on the clamping nut (see note Fig. 1). Tighten the nut until a 20 to 30 inch pound rolling torque is achieved.
9) Tighten clamping bolt on clampnut to 70 inch pounds and recheck rolling torque. Apply inspectors lacquer to head of the bolt.
10) Allow a minimum of 24 hrs. to dry.



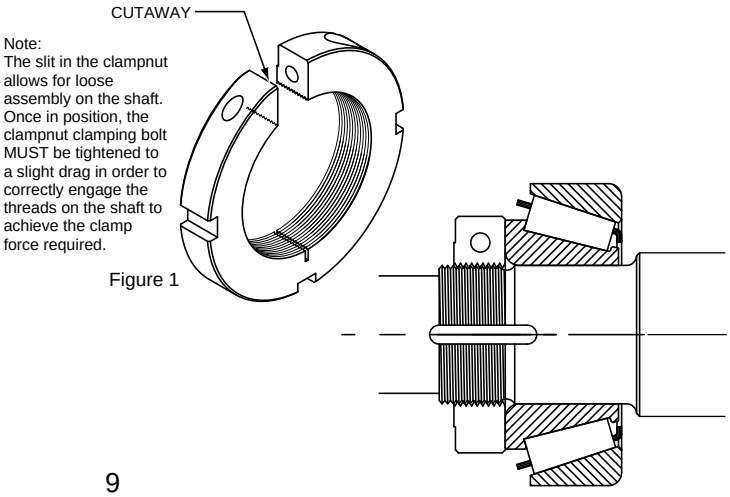

CUTAWAY
Note:
The slit in the clampnut allows for loose assembly on the shaft. Once in position, the clampnut clamping bolt MUST be tightened to a slight drag in order to correctly engage the threads on the shaft to achieve the clamp force required.

Figure 1

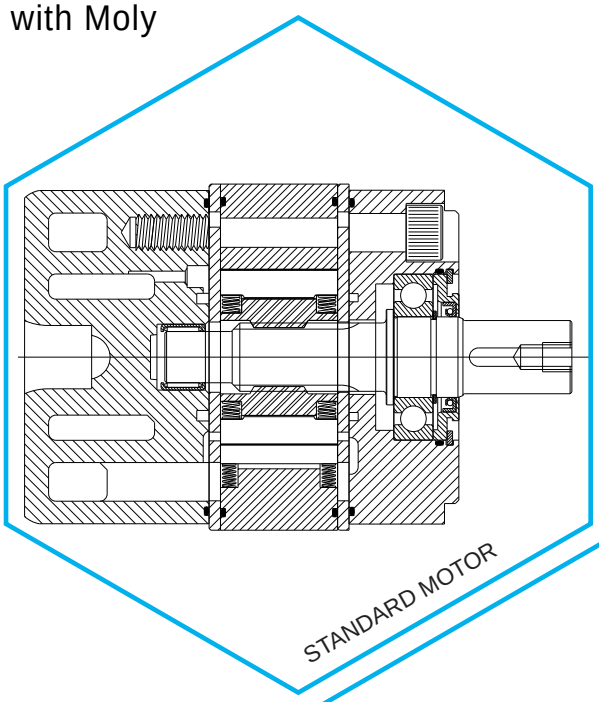
Information:

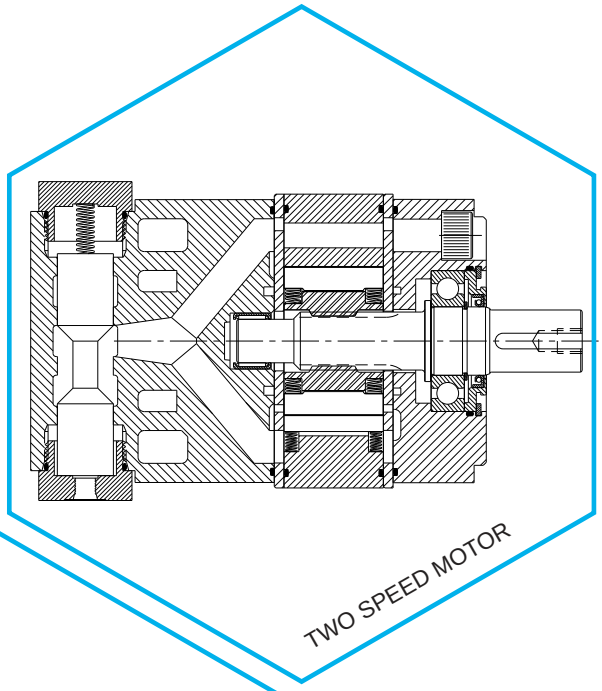
Bolt Torque -
- Main Bolts (5/8-11): 190 ft. lbs.
- Seal Plate (3/8-16)
- (Wheel Motor only): 45 ft. lbs.

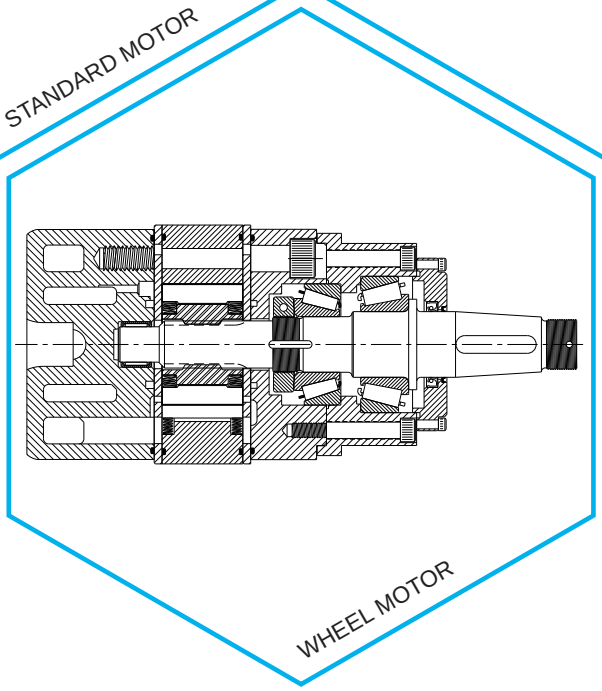
Grease used for bolt threads and o-ring retention:
- Pennzoil 707L RED

Shaft seal assembly lube:
- Mobilgrease special with Moly

Seal Kits:
- Standard 15 series seal kit #0150940
- Standard 15 two speed seal kit #0150940
- Standard 15 wheel motor seal kit #0150936





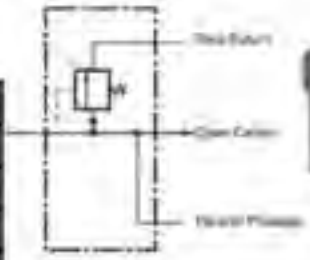


Inlets (2500 psi)

End Inlet

Code	End Port	Top Port
DVA35-A440	1" NPT	1" NPT
DVA35-A880	SAE-16	SAE-16
DVA35-A980	SAE-20	SAE-16
DVA35-A000	NON-PORTED HOUSING	

NOTE: Inlets are machined for a main R/V or R/V plug and are furnished with plastic closures
See Section G, Page 32 for inlet port plugs



Schematic shown with main R/V

Note: For inlets with solenoid section pilot supply machining, see DVG35 inlet section E1

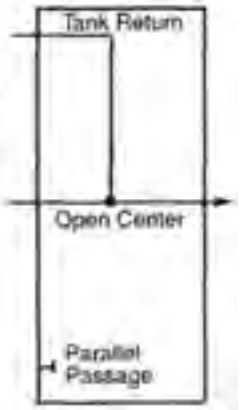
Adjustable Relief Valve Cartridges

For Inlets and Mid-section Inlets

Code	Description
DVA35-MRV-1	Main R/V pressure range 800-2000 psi. Factory set @ 1500 psi @ 50 gpm
DVA35-MRV-2	Main R/V pressure range 2001-2500 psi. Factory set @2500 psi @ 50 gpm.
DVA35-MRVP	Main relief valve plug

Outlets

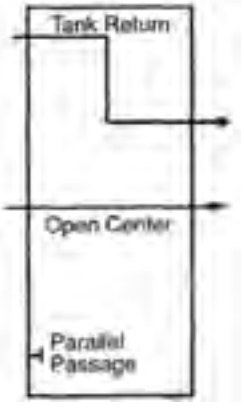
Tank Return Type



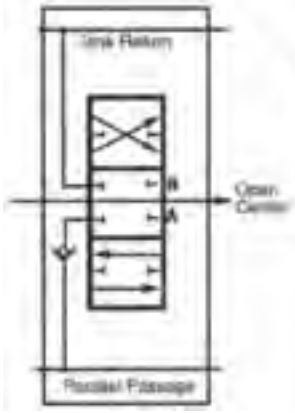
Code	End Port	Top Port
DVA35-TR55	1 1/4" NPT	1 1/4" NPT
DVA35-TR99	SAE-20	SAE-20
DVA35-TR00	NON-PORTED HOUSING	

NOTE: See Section G, Page 32 for Port Plugs

Pressure Beyond Type

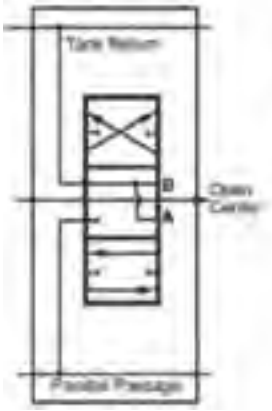


	End Port LP	End Port HP	Top Port LP	Top Port HP
DVA35-PB55	1 1/4" NPT	1 1/4" NPT	1 1/4" NPT	1 1/4" NPT
DVA35-PB90	SAE-20	SAE-20		
DVA35-PB09			SAE-20	SAE-20
DVA35-PB00	NON-PORTED HOUSING			



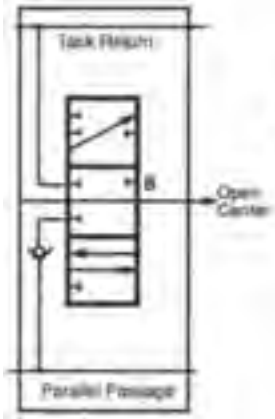
DA8

Double-Acting Section
4-Way, 3-Position, Hold in Neutral
Cylinder Spool



MA8

Double-Acting Section
4-Way, 3-Position, Float in Neutral
Motor Spool



SA8

Single-Acting Section
3-Way, 3-Position, Hold in Neutral
Cylinder Spool

Brief Circuit Descriptions

Series Circuit

Available in DVA20 sections only.

If a machine's work cycle requires simultaneous as well as separate operation of individual hydraulic work functions, a series circuit is right for the job.

As with the other circuits, the oil flows through the open center when all spools are in neutral. There is no parallel passage in standard series sections because they feed directly from the open center passage. If more than one spool is operated, pump flow goes first to the section closest to the inlet. Return flow from the first section is fed back into the open center for use by downstream sections.

Downstream sections can be series, parallel or tandem and will operate in series with the upstream section.

In series circuits, operating pressure is cumulative. Therefore, the sum of the pressures in the circuits can not exceed the circuit or main relief valve setting.

Parallel Circuits

Parallel circuits are the most common on mobile equipment because more than one function can be operated simultaneously and at random. If two or more functions are fully operated at the same time, the one with the lightest load will assert priority because the fluid will take the path of least resistance. However, the operator can divide the flow between functions by metering the spools.

Movement of the spool meters or shuts off the flow of oil thru the open center passage and pressurizes the parallel passage. Oil is then available, at the operator's discretion, to all work ports connected to the parallel passage.

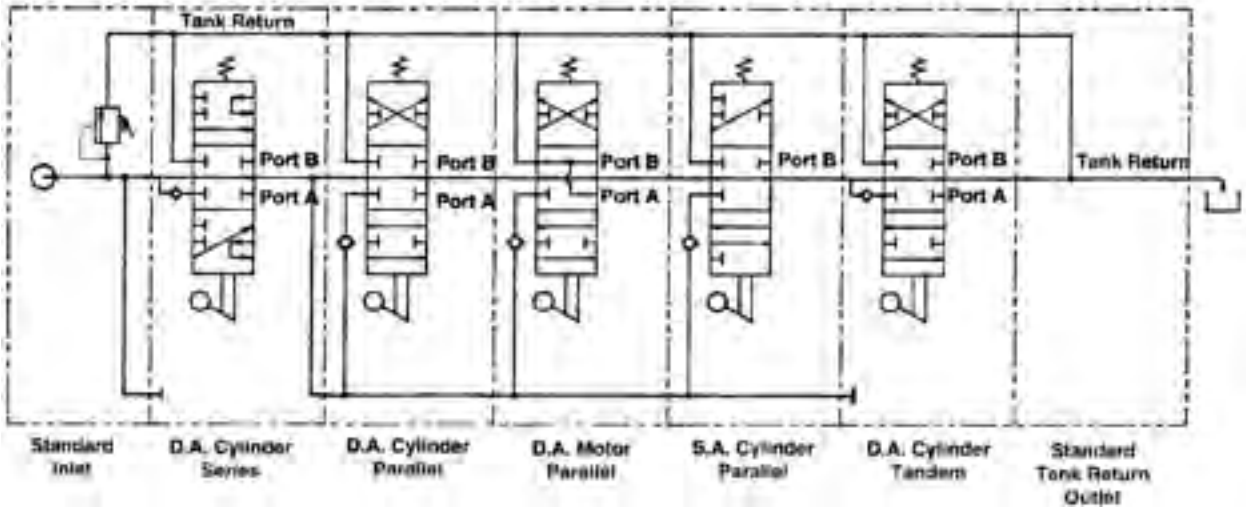
Tandem Circuits

(Not available in the program)

Tandem circuits are sometimes called priority or standard circuits by other manufacturers. Tandem sections feed from the open center passage like series sections but the return flow is directed to the tank return passage and is not available downstream.

If a tandem section is followed by a series or tandem section, operating the tandem section nearest the inlet will assert priority and downstream sections will not function.

Typical Work Section Schematics



Lo-Boy Work Sections -- Parallel Circuits

Code	3-Way 2-Position Hold in Neutral	3-Way 3-Position Hold in Neutral	4-Way 2-Position Float in Neutral	4-Way 4-Position Float Position Detented	Port Size	Work Port (IDT Machines)	Spring Return	4-Position Detent	Manual Hydraulic Operator Control	Solenoid Operated	Air Shift		
DVA35-DA0	•					•	•						
DVA35-DA4	•				1"NPT		•						
DVA35-DA8	•				SAE-16		•						
DVA35-SA0		•				•	•						
DVA35-SA4		•			1" NPT		•						
DVA35-SA8		•			SAE-16		•						
DVA35-MA0			•			•	•						
DVA35-MA4			•		1" NPT		•						
DVA35-MA8			•		SAE-16		•						
DVA35-DK8-12V	•				SAE-16					• 12 VDC			
DVA35-DK8-24V	•				SAE-16					• 24 VDC			
DVA35-DX4	•				1" NPT				•				
DVA35-DX8	•				SAE-16				•				
DVA35-DV4	•				1" NPT						•		
DVA35-DV8	•				SAE-16						•		
DVA35-MX4			•		1" NPT				•				
DVA35-MX8			•		SAE-16				•				
DVA35-DB4	•				1" NPT			•					
DVA35-DB8	•				SAE-16			•					
DVA35-SB4		•			1"NPT			•					

MCCOY MOVING GLOBAL ENERGY FORWARD | DRILLING & COMPLETIONS

VA™/VG™ Valve Service Instructions

INTRODUCTION

This manual has been prepared to assist you in the proper maintenance of the VA20™/VA35™ and VG20™/VG35™/VG80™ directional control valves. Before any work is done, we suggest that you read the assembly and disassembly instructions completely.

The first rule of good maintenance is cleanliness, which includes a clean environment. MAKE SURE YOU DISASSEMBLE AND ASSEMBLE YOUR HYDRAULIC EQUIPMENT IN A CLEAN AREA. Dirt is the natural enemy of any hydraulic system.

GENERAL INFORMATION

The VA and VG model valves are updated versions of our proven A20™ and A35™ units. The VG models are cast from compacted graphite, a high strength iron alloy, which allows the valve to be rated to 3500 psi. VA models are cast from gray iron and are rated at 2500 psi. These open-center, directional-control valves are available in parallel, tandem, and series circuitry. As needed, the sectional, stack-type construction provides flexibility for the addition of subtraction of work sections to an existing valve bank. This design also permits the combination of parallel, tandem, and series circuitry in a single bank. The internal coring of each valve section determines its circuitry and the number of gasket seals required.

All sections with optional features, such as port relief valves, crossover relief valves, and anti-cavitation checks, are dimensionally larger when measured from the top of the port to the bottom of the housing. These are referred to as "hi-boy" sections. Those without work-port options can use the low-profile castings, which are called "lo-boy" sections.

REPLACEMENT PARTS

The illustrations and instructions in this manual apply only to the VA/VG series assemblies, subassemblies, and components. All valve components, except for spools and housings, are available as replacement parts or subassemblies. Spools are hone-fitted to their individual housings, so damage to either of these components means the entire section must be replaced.

We recommend that you use only genuine VA/VG series replacement parts in your service program. Manufactured to the same exacting tolerances and quality controls as the original equipment, genuine VA/VG replacement parts may help prevent premature, component failure and costly downtime. Service parts and assemblies are available through your original equipment dealer or any authorized distributor.

MAINTENANCE

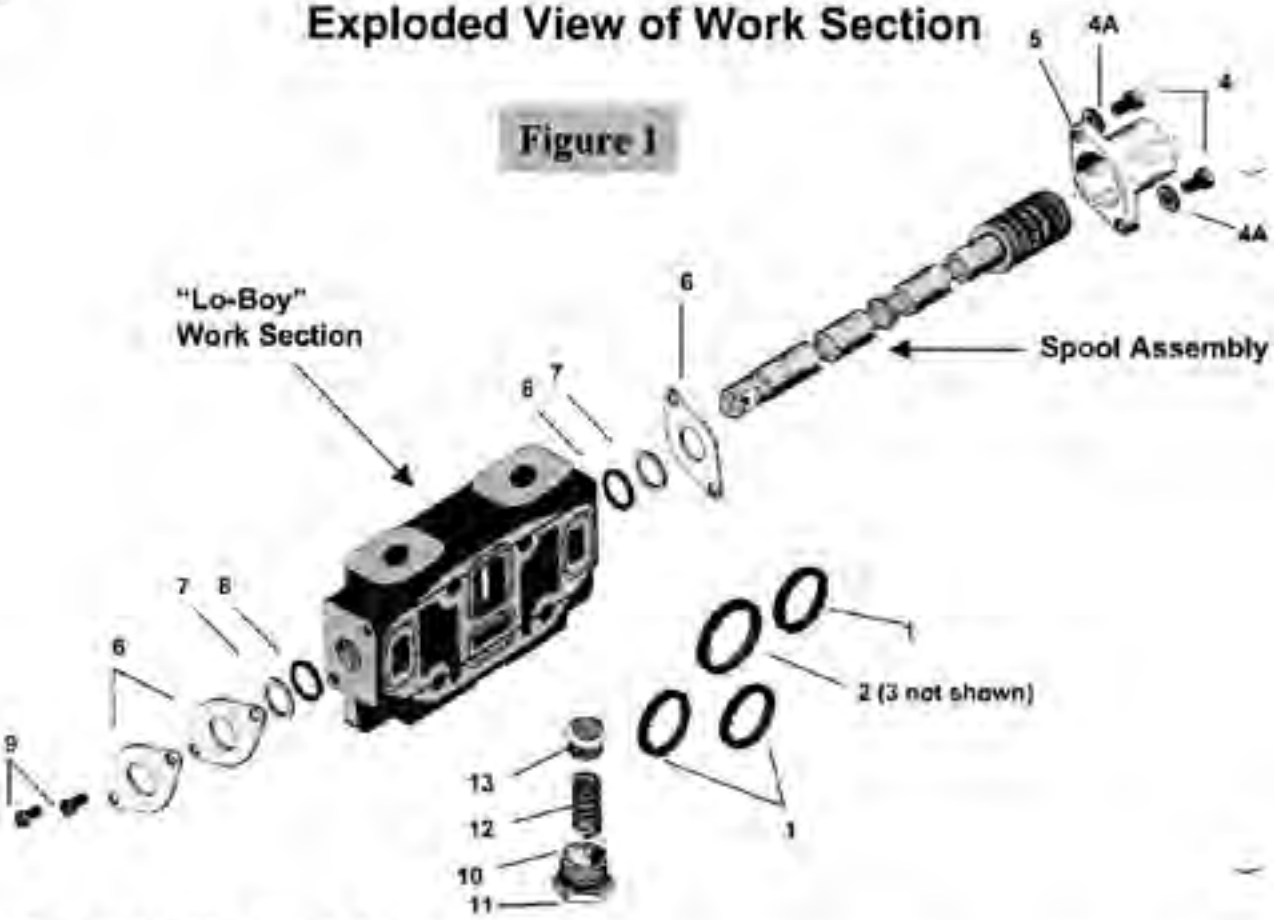
Valves are often used in hazardous environments. Inspect them frequently for damage due to improper use, corrosion or normal wear. If needed, repairs should be made immediately.

Always refer to the machine manual for the proper procedure to remove the valve from the machine.

Remove the valve bank from the equipment, disconnecting all hoses, fittings, control handles and linkage connectors that might be attached to the valve. Plug all ports and thoroughly clean the exterior of the valve bank, then the port plugs can be removed.

Exploded View of Work Section

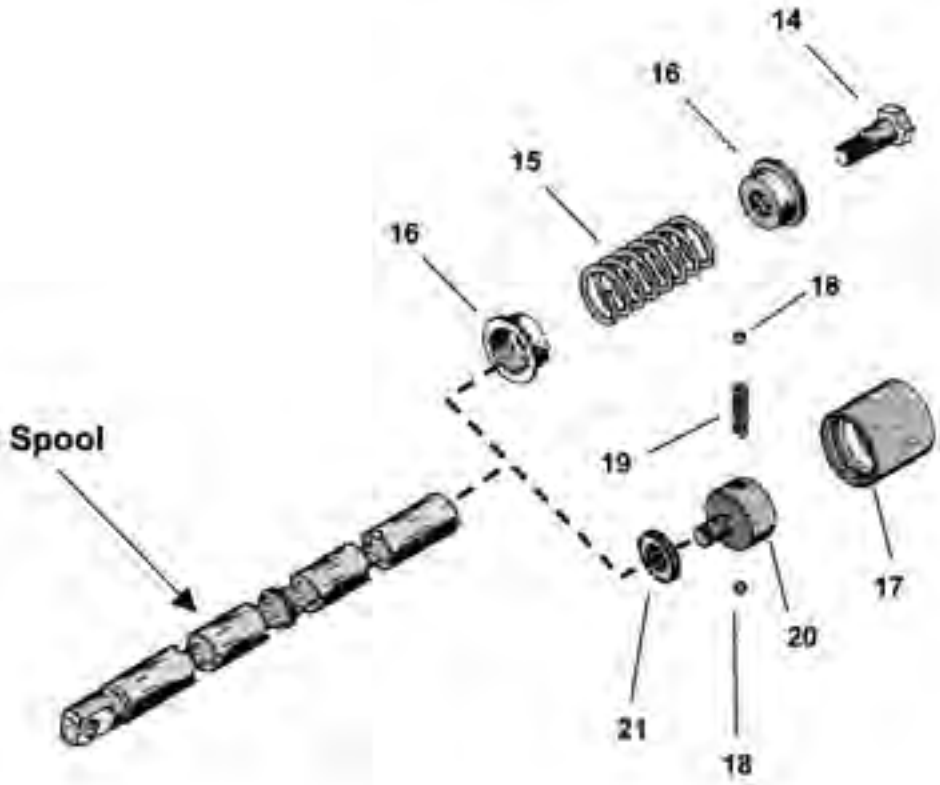
Figure 1



Parts List For Work Section

Item	Description	Qty.	VA/VG20 Part No.	VA/VG35 Part No.	VG80 Part No.
Parallel Section Seals* See Figure 1					
1.	Square Seals	3	391-2881-206	391-2881-200	391-2881-433
2.	Square Seal	1	391-2881-200	391-2681-403	391-2881-670
Series Section Seals					
1.	Square Seals	2	391-2881-206	391-2681-200	.....
3.	Square Seal	1	391-2881-627	391-2681-628	.....
Parallel and Series Section Component Parts. See Figure 1					
4.	Back Cap Screws	2	391-1433-020	391-1433-009	(4) 391-1402-068
4A.	Lock washers	8	.....	.....	391-3783-039
5.	Back Cap	1	341-6000-100	342-6000-100	341-0585-099
6.	Retainer Plates	3	391-2183-001	391-2183-005	391-2183-157
7.	Back up Rings	2	391-2681-378	391-2681-426	391-2681-285
8.	Spool Seals	2	391-1965-014	391-2887-212	391-2681-096
9.	Retainer Plate Screws	2	391-1433-015	391-1433-002	(4) 391-1402-015
10.	Check Valve Cap	1	391-0561-044	391-0561-044	391-0585-099
	Or Valve Cap (F.I.N.)	1	391-2251-015	391-2251-015	.....
11.	O Ring Seal **	1	391-2881-204	391-2881-204	391-2881-249
12.	Check Spring **	1	391-3581-713	391-3581-713	391-3581-775
13.	Check Valve Poppet **	1	391-2461-069	391-2461-069	391-2383-091

*Parallel Sealing Face Includes inlets and mid-inlets.
**Not required in Float-in-neutral Sections.



Spring Centered and Detent Spool Operators. See Figure 2

14.Stripper Bolt	1	391-1432-022	391-1432-021	391-1402-452
15.Centering Spring	1	391-3581-608	391-3581-633	391-3581-330
16.Spring Guides	2	391-1642-045	391-1642-013	391-1642-161
17.Detent Sleeve	1	391-3283-015	391-3283-008	391-3384-310
18.Detent Balls	2	391-0282-010	391-0282-009	391-0282-011
19.Detent Spring	1	391-3581-130	391-3581-015	391-3581-316
20.Detent Poppet Retainer	1	391-2583-008	391-2583-006	391-3384-311
21.Detent Spacer	1			391-3782-208

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Valve Disassembly Instructions

Reference exploded view and parts list on page 2 and 3 for work section detail.

Step 1 - Valve Bank

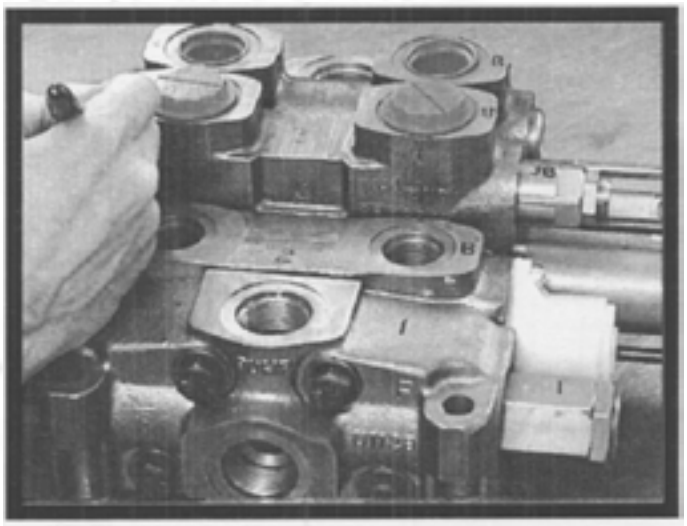
This step is the most critical in the disassembly procedure. It should be followed closely to ensure that the valve bank is properly reassembled after repairs have been made.

With a waterproof, quick-drying marker, mark each casting with a sequential number. Start by marking the inlet casting with the #1 and finish by marking the outlet with the highest number.

Next, mark the port boss closest to the back cap on each work section with a "B" (for back cap end).

Then, mark the port boss closest to the spool clevis on each work section with a "C" (for clevis end).

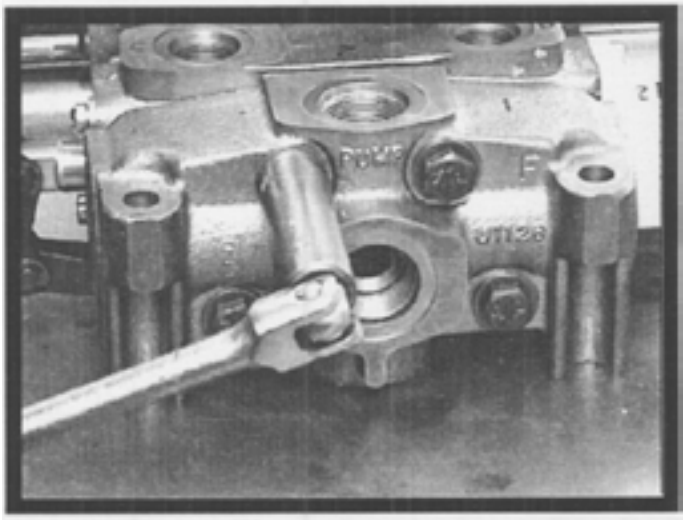
Finally, if relief valves are removed from the valve bank they must be marked with the corresponding number of the casting and port location (B or C) from which they were removed. Inlet and mid-inlet relief valves are marked with a casting number only.



Step 2 - Tie Bolts

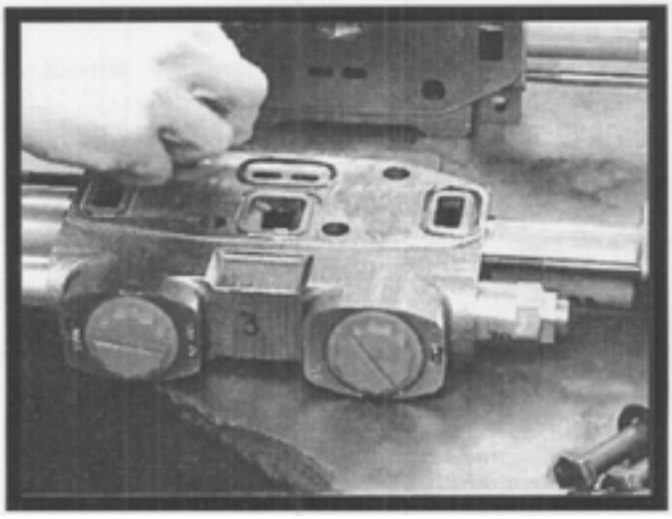
Remove the four, tie bolts that hold the bank together and separate the sections.

NOTE: VA valve tie bolts thread into the outlet casting. VG valve tie bolts pass through the entire bank, requiring washers and hex nuts to be fastened at both ends of the bolt.



Step 3 - Section Seals

The inlet, mid-inlet and each parallel work section have four, section seals. (Fig. 1, items 1 & 2) on the downstream, mating face. Series work sections and the VA/VG35 split flow mid inlets have three section seals on the downstream mating face. (Fig. 1, items 1 & 3.) These section seals should be removed and discarded.



REMINDER: ALL WORK MUST BE PERFORMED IN A CLEAN AREA.

Valve Disassembly Instructions

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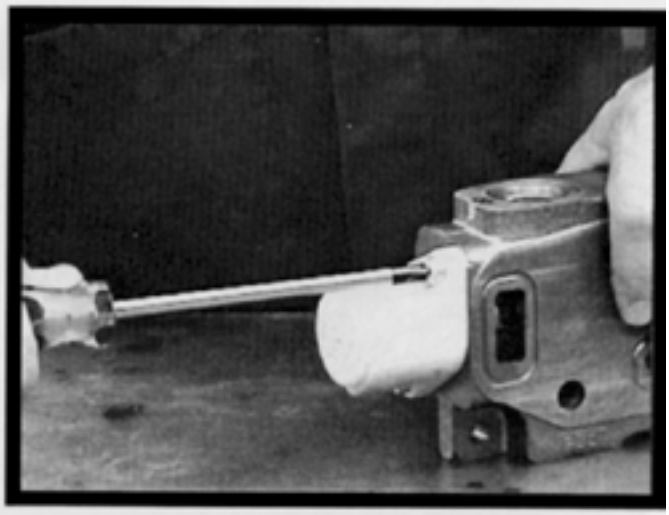


Step 4 - Valve Back Cap

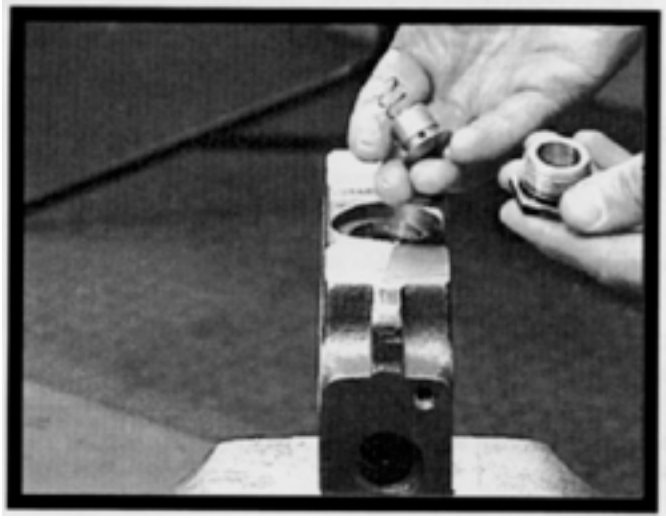
Using a large, Phillips-head screwdriver, remove the two, cap screws (Fig. 1, item 4) which fasten the back cap to the work section. Lightly tap the end of the screwdriver handle with a hammer to break adhesive. Remove the back cap (Fig. 1, item 5).

Step 5 - Control Spool and Seals

Grasp the spring end of the spool with a clean, lint-free cloth and pull the spool out of the housing using a twisting motion. Generally, the rear, retainer plate (Fig. 1, item 6) back-up ring (Fig. 1, item 7) and spool seal (Fig. 1, item 8) will come out with the spool.

CAUTION: For detented spool models, be careful not to remove the detent poppet sleeve (Fig. 2, item 17) unless it is to be serviced.

Using a large, Phillips-head screwdriver, remove the two, retainer-plate screws (Fig. 1, item 9) from the spool clevis end of the work section. Lightly tap the end of the screwdriver handle with a hammer to break the adhesive. Remove the two, retainer plates (Fig. 1, item 6) the back-up ring (Fig. 1, item 7) and the spool seal (Fig. 1, item 8). Tag or mark with the appropriate, work section identification number. (See Step 1.) Spool seals (Fig. 1, item 8) and back-up rings (Fig. 1, item 7) should be discarded.



Step 6 - Transition Check

The transition check is located in the bottom center of the work section housing. Carefully clamp the work section in a vise with ports down. Do not clamp on the machined surface. Remove the check-valve cap (Fig. 1, item 10) and its O-ring seal (Fig. 1, item 11). Discard the seal. Remove the check spring (Fig. 1, item 12,) and the check-valve poppet (Fig. 1, item 13).

NOTE: Only cylinder work sections (ports blocked in neutral) have a transition check. Motor sections have only a cap plug.

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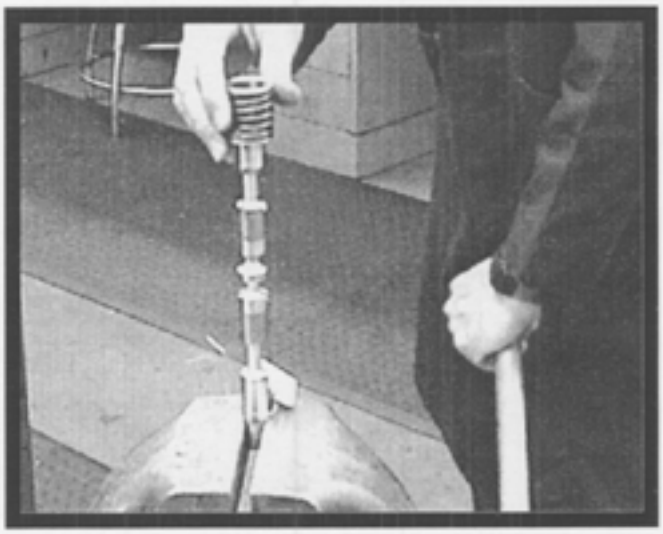
Valve Disassembly Instructions

Spool Disassembly

Spring Centered Spool

The spring assembly should not be removed from the spool unless these parts need to be replaced. Once the spool is free of the work section housing, it must be handled carefully to avoid damage. Place the spool vertically in a soft-jawed vise, clamping on the flat, spool clevis, and remove the stripper bolt (Fig. 1, item 14) with a wrench.



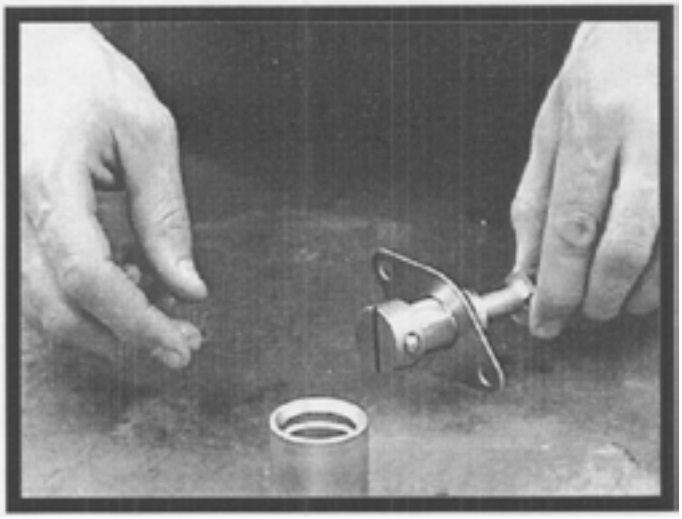
Lightly tap the stripper bolt with a hammer and a punch to help break the adhesive. Cautious application of heat may be required to free the stripper bolt, since an anaerobic thread adhesive was used during its assembly.

CAUTION: Too much heat may distort the spool.

As the stripper-bolt threads disengage, the spring (Fig. 2, item 15) and spring guides (Fig. 2, item 16) will release abruptly from the spool.

Detent Spool

The detent assembly should not be removed from the spool unless these parts need to be replaced. Wrap the detent sleeve (Fig. 2, item 17) with a clean, lint-free cloth. Grip the cloth-covered sleeve and pull firmly. As the sleeve moves backwards, the detent balls (Fig. 2, item 18) and the detent spring (Fig. 2, item 19) will release abruptly. The cloth should capture these parts and prevent their loss.



Next, clamp the spool in a soft-jawed vise and remove the detent popper retainer (Fig. 2, item 20). Place an undersized bar through the detent ball bore to serve as a wrench. Lightly tap the detent popper retainer with a hammer and a punch to help break the adhesive. Cautious application of heat may be required again, since an anaerobic adhesive was also used in the detent retainer assembly.

CAUTION: Too much heat may distort the spool!

CLEANING, INSPECTION, AND REPAIR

1. Inspect the spool bore, transition check seat and spool from each section for deep scratches, gouges or excessive wear. If any of these conditions exist, replace the section. Minor, surface damage on the control spool and check popper can be carefully polished away with a very fine, emery cloth.

2. Examine the machined surfaces of the valve housing for nicks and burrs that could cause leakage between sections. Lightly stone these surfaces to remove any rough spots.

CAUTION: A shallow-milled relief area extends across the O-ring face of the valve housing. This should not be stoned or ground off!

3. Wash all parts thoroughly in a cleaning solvent and blow dry before beginning reassembly. Pay special attention to the number and letters marked on the parts in Step 1. If any marks are removed during cleaning, re-mark immediately.

4. Clean adhesive from threads of spool, stripper bolt, housing, cap screws and hex nut with Loctite™ Chisel Gasket Remover.

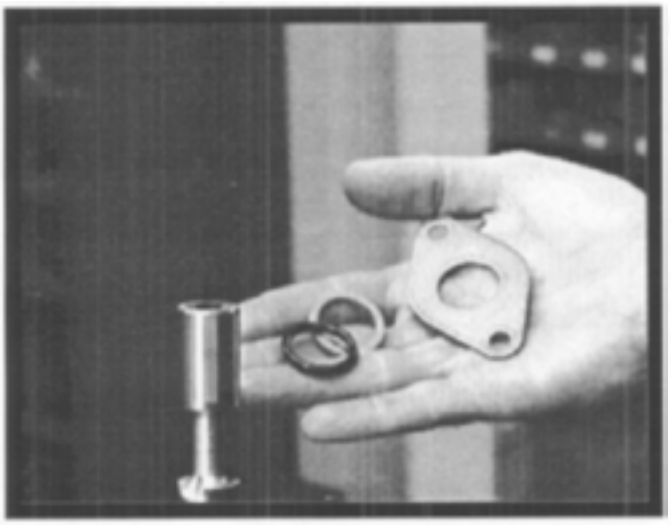
Valve Assembly Instructions

Preparation of Parts

Spray the threads of the new stripper bolt (Fig. 2, item 14) tapped-threaded spool end, all screws and screw holes on both ends of the housing with LOCQUIC Primer Grade NF™ and let dry.

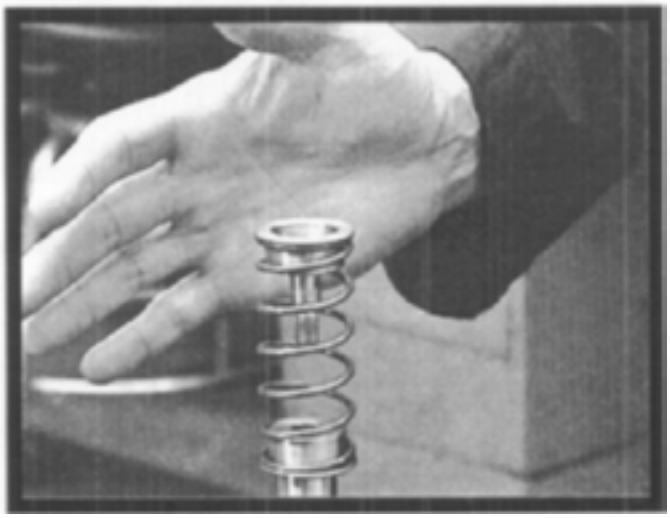
CAUTION: Failure to follow the recommended assembly instructions can result in poor performance or product malfunction. Product should be thoroughly tested to ensure proper operation before the valve is placed back into service.

Spring Center Spool Assembly



Step 1 - Spool Assembly-Spring Centered

Clamp the flat, clevis end of the control spool in a soft jawed vise. Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the end of the spool away from the clevis. Slide on the back-up ring (Fig. 1, item 7) and retainer plate (Fig. 1, item 6). Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches



Step 2 - Attach Spring Guides and Spring

Apply 2 - 3 drops of Locnut 262™ or equivalent anaerobic adhesive near the middle of the female threads in the spool. Assemble the spring guides (Fig. 2, item 16) centering spring (Fig. 2, item 15) and stripper bolt (Fig.2, item 14,) onto the spool (Reverse of Step 7) Torque the stripper bolt to 175 in. lbs. +/-4 in. lbs.

CAUTION: Care must be taken to ensure that the spring retainer is not pinched under the shoulder bolt during assembly. This can result in burrs that may cause spool binding. Check for binding by compressing the spring and guides or by rotating the spring guide nearest the housing.

CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure!

Lightly coat the centering spring with high- temperature grease to prevent rusting. Set the spool assembly aside and let it cure for a minimum of 1 hour. After curing, test the stripper bolt to make certain it can withstand 125 in. lbs. of breakaway torque.

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Valve Assembly Instructions

Detent Spool Assembly

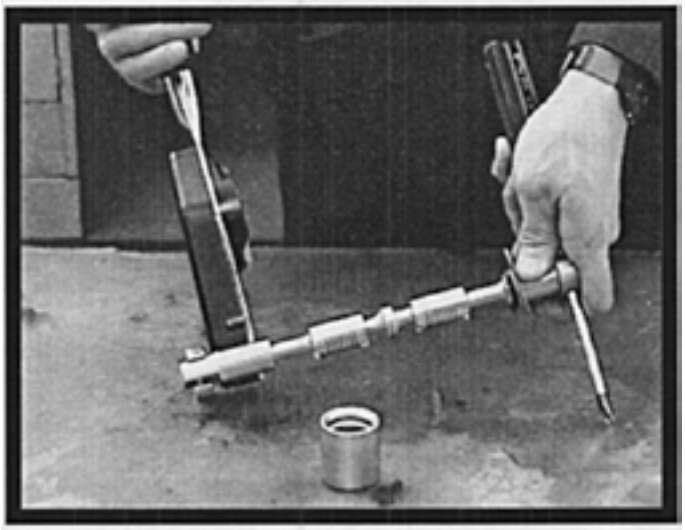
Step 1 - Spool Assembly-Detent

Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide the back-up ring (Fig. 1, item 7) and one retainer plate (Fig. 1 item 6) onto the spool. Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches. Apply 2 - 3 drops of Loctite 262™ or an equivalent, anaerobic adhesive near the middle of the female threads in the spool.

CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure.

Step 2 - Spool Assembly-Detent

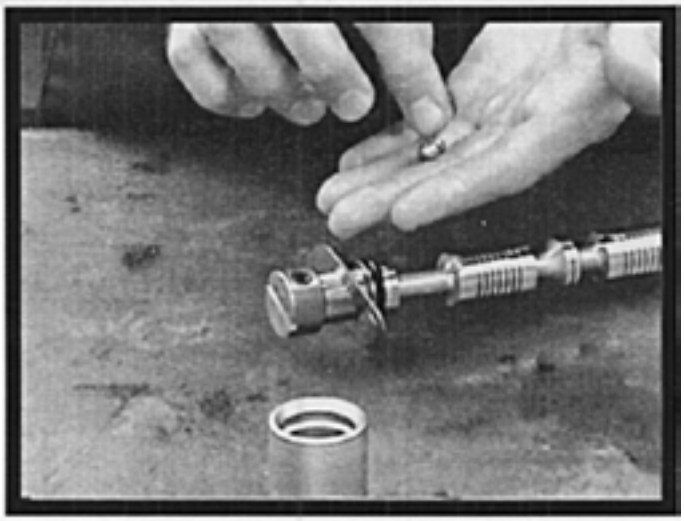
Thread the detent ball retainer (Fig. 2, item 20) into the spool end. Torque the detent ball retainer to 175 in. lbs +/-4 in. lbs., This can be accomplished by using a crows-foot socket on the flats of the clevis, and holding the spool by inserting a round, steel rod or screwdriver through the hole in the ball retainer.



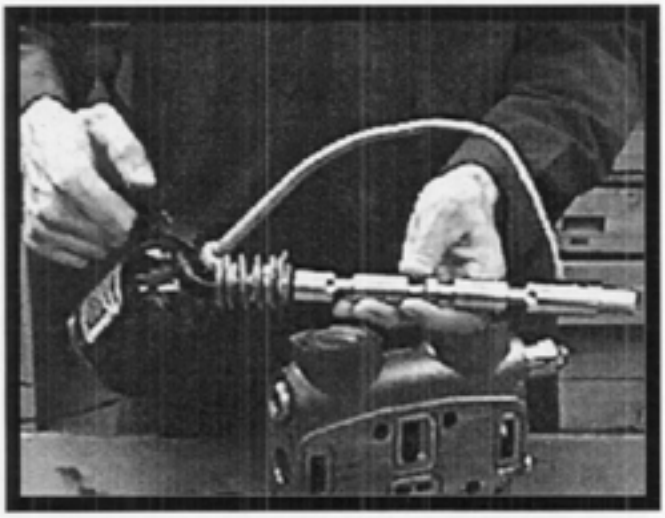
Step 3 - Detent Balls and Spring

Next, lightly coat the detent balls (Fig. 2, item 18) detent spring (Fig. 2, item 19) and entire inside diameter of the detent sleeve (Fig. 2, item 17) with high-temperature grease.

Insert the detent spring into the through hole in the detent ball retainer. Place the steel balls on the ends of the spring. Compress the balls and spring, then slip on the detent sleeve. (Note: The detent sleeve is not symmetrical, one end of the sleeve has a lead-in chamfer. This chamfer must face the spool clevis when assembled.) Move the detent sleeve to the neutral or middle position to prevent the subassembly from separating during subsequent steps.



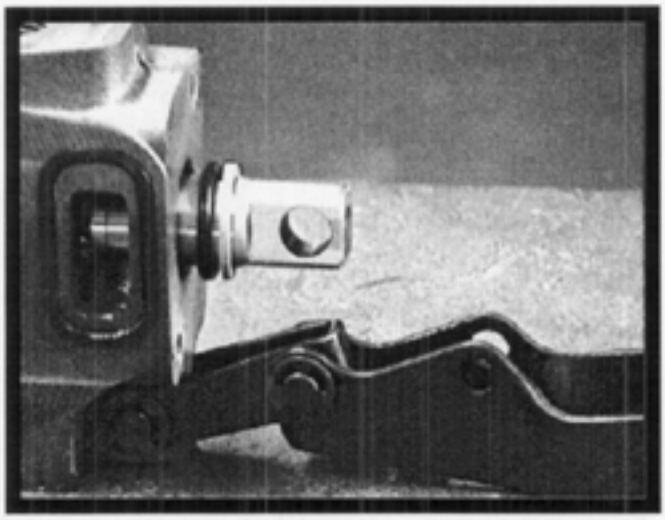
Valve Assembly Instructions



Step 1 - Spool Subassembly

Apply 2 - 3 drops of Loctite 262™ or equivalent to the fillister screw holes on both ends of the housing.

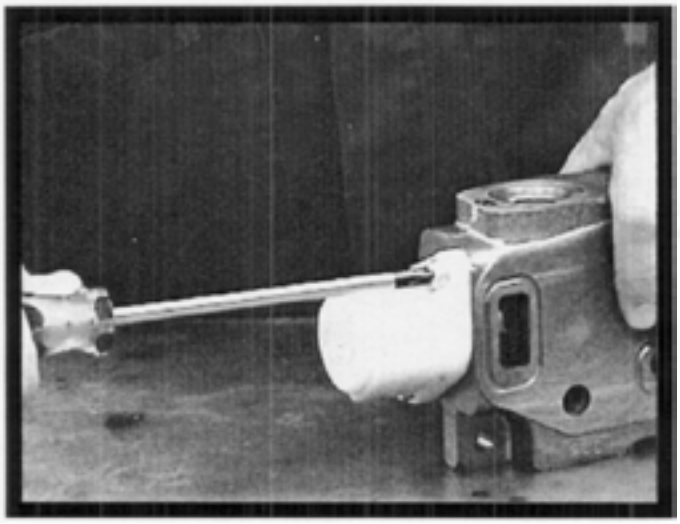
Apply a light coating of clean, hydraulic oil to the valve spool. Carefully insert the spool assembly into the housing. Use caution to avoid causing burrs. Be careful not to pinch, roll or damage the seals. Make sure that the spool and housing are in the proper orientation (see Step 1, page 6 disassembly).



Step 2 - Spool Seal and Back up

Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide on the back-up ring (Fig. 1, item 7). Push both items into the counter-bore until they bottom out.

Assemble the two, front retainer plates (Fig. 1, item 6) using the two short, fillister screws (Fig. 1, item 9). Check retainer plates for proper alignment. Tighten to a final torque of 34 in. lbs. +/- 2 in. lbs.



Step 3 - Back cap

Install the back cap using the two, long, fillister screws (Fig. 1, item 4). Tighten to a final torque of 34 in. lbs. +/- 2 in. lbs.

Caution: Excessive torque will damage the back cap ears!

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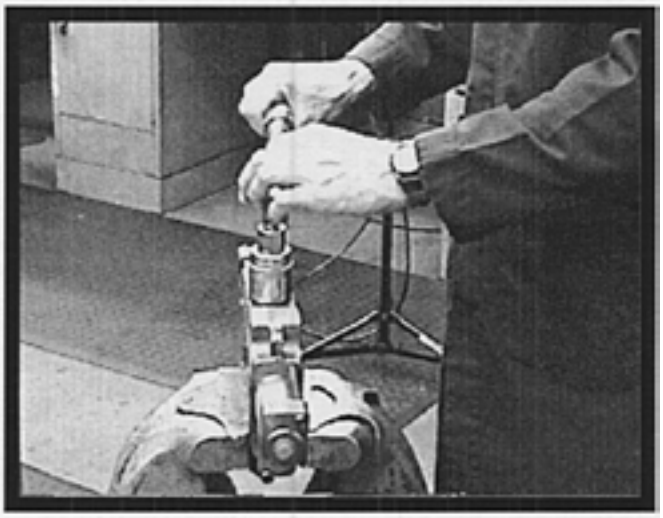
Valve Assembly Instructions

Step 4 - Install Transition Check

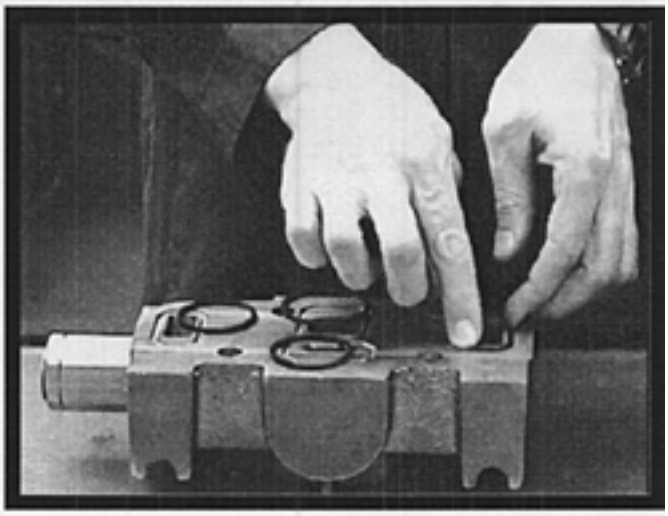
Inspect transition check components for cleanliness. Install check poppet (Fig. 1, item 13) into the transition check cavity. Align the check spring (Fig. 1, item 12) square to the poppet, then carefully place the check cap (Fig. 1, item 11) over the poppet and spring. Turning by hand, engage several threads. Tighten to a final torque of 75 ft. lbs. +/-4ft. lbs.



Step 5 - Relief Valves

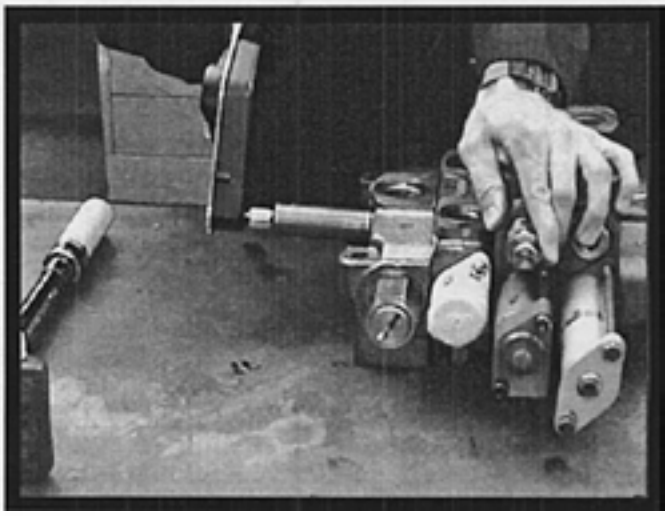
Return all relief valves to their proper positions and torque to 75 ft. lbs

Install new, section seals. Place section seals (Fig. 1, items 1 & 2, or items 1 & 3) in the proper grooves. Make certain seals stay in their grooves during assembly.



Step 6 - Install Tie Bolts

Slide the tie bolts through the inlet casting. If cap screws are used, place a washer on the cap screw prior to installation. Place the valve sections on the tie bolts in their proper sequence (see Step 1, page 4). Turning by hand, engage several threads in the outlet. If it is a VG series assembly, assemble nut and washer to either end of the stud and follow above instructions. Torque the tie bolts in a cross-corner pattern.



Tie Bolt Torque Values
VA20 - 29 ft. lbs. (348 in. lbs.)
VG20 - 42 ft. lbs. (504 in. lbs.)
VA35 - 34 ft. lbs. (408 in. lbs.)
VG35 - 75 ft. lbs. (900 in. lbs.)
VG80 - 150 ft. lbs. (1800 in. lbs.)

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Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Oil leaks between sections	Pinched, blown or missing section seal	Replace section seal
	Stud fasteners not correctly torqued	Replace section seals and re-torque
	Mounting plate not level	Loosen mounting bolts and shim as required
	Contamination/burrs on seal	Clean seal groove, replace section seal
Oil leaks at either end of spool	Over-pressurized tank core	Correct high, back-pressure condition
	Worn or damaged spool seals	Replace seals and seal retainers
Spring - centered spools do not return to neutral	Broken centering spring	Replace centering spring
	Misalignment of operating linkage	Check linkage for mechanical binding
	Foreign particles in system	Clean valve and system
Load will not hold	Cylinder leaking or worn	Check cylinder - repair
	Port relief valve not holding	Remove and clean or replace
	Spool or housing scored or worn excessively	Replace section
Load drops when spool moved from neutral	Dirt or foreign particles lodged between check-valve poppet and seat	Disassemble, clean & reassemble
	Scored or sticking check-valve poppet	Replace poppet
No motion, slow, or erratic system operation	Worn pump	Check flow & pressure
	Defective cylinder or motor	Repair or replace
	Low-reservoir oil level	Add oil to specifications
	Clogged suction strainer	Clean or replace
	Suction line restricted	Check lines
	Relief valve not properly set	Check pressure setting
	Relief valve poppet or seat scored & sticking open	Replace relief valve
	Valve spool not shifted to full stroke	Check spool linkage travel

Pilot-to-open, spring biased closed, unbalanced poppet logic element

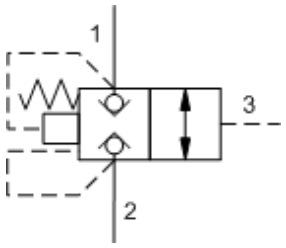
Capacity:
15 gpm (60 L/min.)

Functional Group:
Products : Cartridges : Logic Element : Unbalanced Poppet : Pilot-to-open, spring biased closed

Model:
LKDC-XDN

Product Description

These unbalanced poppet, logic valves are 2-way switching elements that are spring-biased closed. Pressure at either work port 1 or 2 will further bias the valve to the closed position while pressure at port 3 will tend to open it. The force generated at port 3 must be greater than the sum of the forces acting at port 1 and port 2 plus the spring force for the valve to open. NOTE: The pilot area (port 3) is 1.8 times the area at port 1 and 2.25 times the area at port 2.



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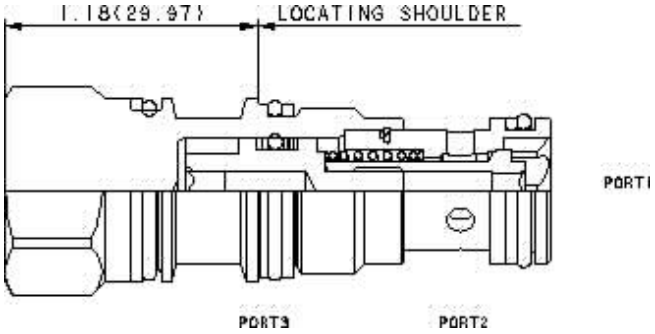


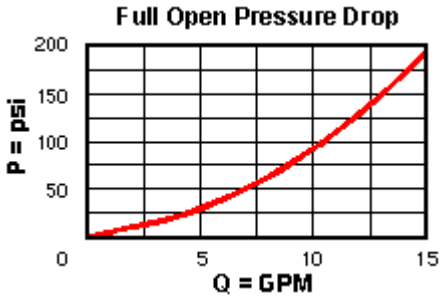
Technical Features

- Because these valves are unbalanced, operation is pressure dependent. Opening and closing of the poppet are functions of the force balances on three areas: Port 1 = 100%, Port 2 = 80%, and Port 3 = 180%.
- These valves are pressure responsive at all three ports, therefore it is essential to consider all aspects of system operation through a complete cycle. Pressure changes at any one port may cause a valve to switch from a closed to an open position, or vice versa. All possible pressure changes in the complete circuit must be considered to assure a safe, functional system design.
- These valves have positive seals between port 3 and port 2.
- All ports will accept 5000 psi (350 bar).
- Stainless steel cartridge options P or W are intended for use within corrosive environments with all external components manufactured in stainless steel or titanium. Internal working components remain the same as the standard valves.
- Incorporates the Sun floating style construction to minimize the possibility of internal parts binding due to excessive installation torque and/or cavity/cartridge machining variations.

Technical Data

	U.S. Units	Metric Units
Model Weight	0.28 lb.	0.13 kg.
Cavity	T-11A	
Capacity	15 gpm	60 L/min.

Area Ratio, A3 to A1	1.8:1	
Area Ratio, A3 to A2	2.25:1	
Maximum Operating Pressure	5000 psi	350 bar
Maximum Valve Leakage at 110 SUS (24 cSt)	10 drops/min.@1000 psi	10 drops/min.@70 bar
Pilot Passage into Valve	.031 in.	0,8 mm
Pilot Volume Displacement	.02 in³	0,33 cc
Series (from Cavity)	Series 1	
U.S. Patent #	4,795,129	
Valve Hex Size	7/8 in.	22,2 mm
Valve Installation Torque	30 - 35 lbf ft	45 - 50 Nm
Seal Kits	Buna: 990-011-007	
Seal Kits	Viton: 990-011-006	



LKDC-XDN

Control	Minimum Pilot Pressure	External Material/Seal Material
X Not Adjustable +0.00	**D** 50 psi (3,5 bar) +0.00	**N** Buna-N +0.00

If the material/seal is P, the control must be X
If the material/seal is W, the control must be X

- Explanation of Sun cartridge control options - US units.
- Explanation of Sun cartridge control options - metric units.

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